SPAULDING & SLYE

COLLIERS INTERNATIONAL

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ANNUAL REVIEW AND ANALYSIS OF REAL ESTATE TRENDS IN THE LIFE SCIENCE INDUSTRY

ALCHEMY: A MEDIEVAL CHEMICAL PHILOSOPHY HAVING AS ITS ASSERTED AIMS THE TRANSMUTATION OF BASE METALS INTO GOLD, THE DISCOVERY OF THE PANACEA, AND THE PREPARATION OF THE ELIXIR OF LONGEVITY.

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THE SYNTHESIS OF MARKET
ANALYSIS, TECHNOLOGY,
AND EXPERIENCE CREATE THE
INNOVATIVE ENVIRONMENTS
THAT ACCELERATE FUTURE
DISCOVERIES.
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The mapping of the human genome ushered in a new era of research and medicine. With this spectacular accomplishment scientists can now decipher how to build and run the human body. The next challenge will be to marshal this information to discover new diagnoses and treatments for inherited diseases as well as those diseases with causes influenced by genes.

New discoveries in genomics (the study of genes and their structure), proteomics (the study of the protein building-blocks of genetic material), nanotechnology (the mechanics of structures that operate at the molecular level), and bioinformatics (the application of information technology and computer science to decipher complex biological processes) are changing not only our basic understanding of human life, but also medical science and clinical delivery systems. In turn, these advances are indirectly transforming the geographic areas where such life science activity is concentrated.

Last year, The Brookings Institution detailed how the complex interaction of scientific research with medical practitioners and entrepreneurial company managers led to the formation of nine economically strong, dynamic and growing life science "clusters" throughout the United States. Several smaller and more specialized clusters are emerging in other areas as well. Today, institutions and companies in these clusters are producing new products, generating millions of dollars in revenue and creating thousands of specialized, high-paying jobs for life science workers.

All of this activity has come at an enormous cost, however. National health expenditures have increased from 10% of gross domestic product in 1985 to nearly 14% in 2003 and are projected to rise to approximately 17% by the year 2010. The societal challenge will be to speed drug development from the bench to the bedside, reduce the cost of healthcare delivery and make it accessible to all.

This challenge will require radical changes not only in science and in medicine, but also in the environments and buildings where these activities take place. The right environment can encourage multidisciplinary interaction, stimulate creative thinking and speed drug development and delivery. In addition, real estate can be mobilized as a strategic resource that will allow life science institutions to maintain economic viability and to advance scientific and medical goals at a lower cost.

This report addresses the growing need for knowledge about a very specialized life science real estate product and the national and worldwide life science real estate markets. It is the first report of its kind. We intend that it will provide a foundation for further analysis and annual coverage in the future. The development of this report was a collaborative effort between Spaulding & Slye Colliers and our Colliers affiliates across the country. We welcome your questions, comments, and suggestions.

Nancy J. Kelley, Senior Vice President and Managing Director, Life Sciences
Spaulding & Slye Colliers
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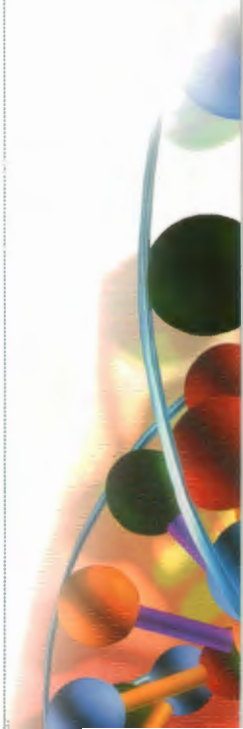


Spaulding & Slye Colliers Life Science Group

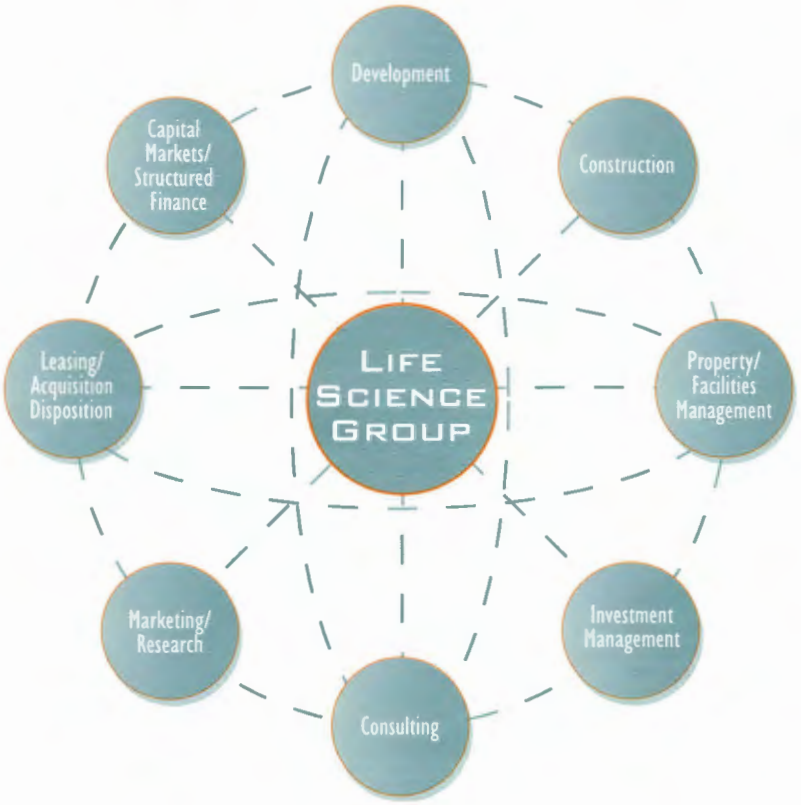
In life science research, integration is a powerful force. Even the most promising molecules, in isolation, rarely have much impact. Put the right combination together and something magical happens. Something powerful. Something that transforms human health.

The same is true in real estate. Spaulding & Slye Colliers provides innovative real estate solutions to the life science industry worldwide, through a dedicated group of more than 110 professionals in structured finance and investment sales, development, construction, leasing and facility management. Through the Colliers International network, the Group has a major presence in each of the nine life science clusters in the United States, Canada, Europe and Asia, bringing a truly global understanding of the developments driving the life science industry, a national understanding of the U.S. market and a local perspective as a major player in each local market it serves. In collaboration with Colliers affiliates, the Spaulding & Slye Colliers Life Science Group developed this report.

Spaulding & Slye Colliers life science clients include: the National Institutes of Health (NIH), Johns Hopkins University, Massachusetts Institute of Technology (MIT), New York-Presbyterian Hospital: The University Hospitals of Columbia and Cornell, Boston University/Boston Medical Center, Pfizer, Genzyme and Perkin Elmer.

Our formula of experience + talent + market research + proprietary technological tools creates exceptional environments that inspire innovation and speed drug development. We have earned a solid reputation for rapid, on-time and under-budget delivery of the most sophisticated life science projects for the world's leading research centers and largest life science companies.

TOGETHER, WE MAKE IMPOSSIBLE CHALLENGES, POSSIBLE.



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Colliers International is a global real estate services firm with 8,684 employees in 247 offices in 53 countries generating $1.035 billion in annual revenue and over $28 billion of annual transactions and services. It offers a complete range of services on a local, regional and international basis to tenants, owners and investors.

Colliers was among the first commercial real estate companies to recognize the importance of local knowledge on a global scale. Twenty five years ago, Colliers joined together commercial firms in the United States, Europe, Canada, Asia, the Middle East and Africa to provide consistent, superior service in multiple locations.

This pioneering tradition of global breadth and local depth continues today and sums up Colliers' unique approach to the business of commercial real estate. By having the best firms around the world gathered under the umbrella of a single partnership, Colliers International provides clients with superior global service through local in-depth knowledge and expertise.

"OUR STRENGTH BEGINS IN YOUR MARKET . . . AND TAKES YOU ANYWHERE IN THE WORLD."

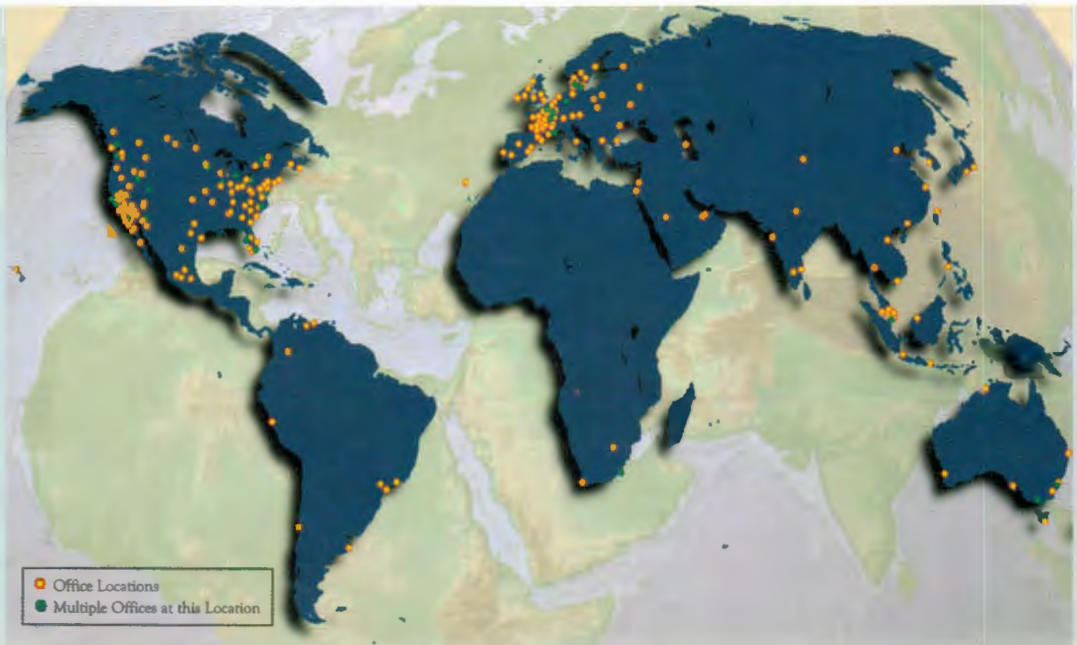
SPAULDING & SLYE COLLIERS

Founded in 1966 as an at-risk development company, Spaulding & Slye Colliers has expanded into one of the premier, full-service real estate firms in the New England and mid-Atlantic markets, with national and global access through Colliers International. In Spaulding & Slye Colliers' 38-year history, it has completed over 200 development projects totaling over 27.7 million square feet. It provides comprehensive real estate services in the disciplines of structured finance, development, construction, property and facility management, leasing and investment sales. The firm currently employs approximately 430 real estate professionals in its Boston and Washington D.C. locations.

Over the years, Spaulding & Slye Colliers has developed outstanding external resources to benefit its clients. The firm's strong relationships with lenders, investors, public officials, architects, engineers and attorneys enable it to successfully control the many details inherent in the risky process of life science real estate management.

Because Spaulding & Slye Colliers can provide a wide spectrum of real estate services, it offers the efficiency of consolidation: one firm to handle diverse real estate needs. Since most clients' real estate requirements are unique, Spaulding & Slye Colliers helps to identify goals and plan strategies that best meet those goals.

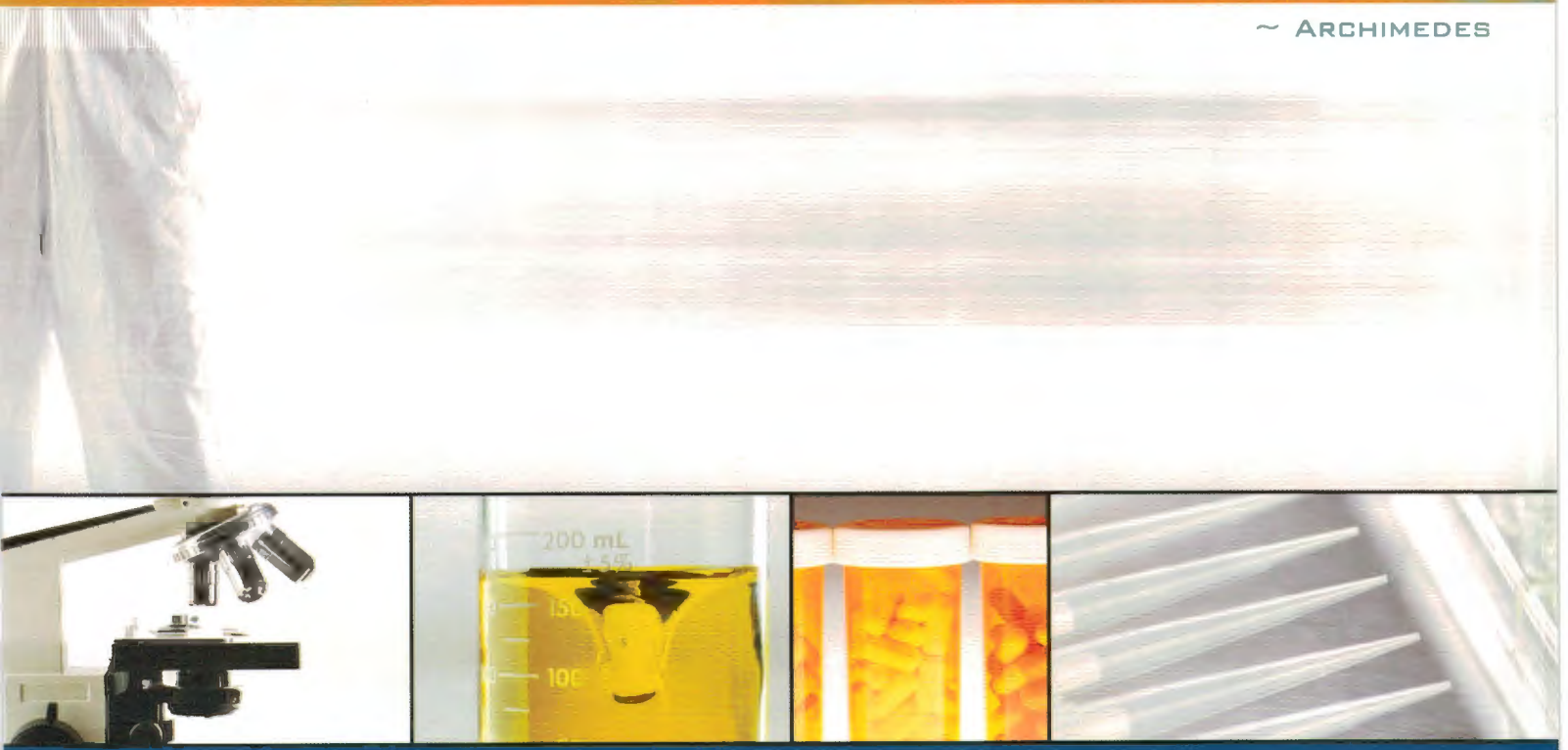
Colliers International worldwide network has 247 offices in 53 countries.



"Give me a place to stand and I will

MOVE THE EARTH."

~ Archimedes



THE STATE OF THE LIFE SCIENCE REAL ESTATE

Industry

The life science real estate industry is a relatively new marketplace defined by the convergence of science, medicine and commercialization in global efforts to improve human health. It is expanding rapidly, especially amongst larger life science companies and institutions – both academic and medical. This growth is fueled by an aging population, with chronic healthcare needs, revolutionary scientific advancement and medical discoveries. The industry has tended to "cluster" in geographic areas with good quality of life, where research, investment and technology transfer takes place. It requires a specialized infrastructure, that is expensive to build and complicated to maintain. Despite the challenges of the marketplace, however, this is an exciting time for this emerging industry. New scientific developments, as well as new initiatives at the federal, state and local governmental levels will ensure continued growth and expansion for some time to come

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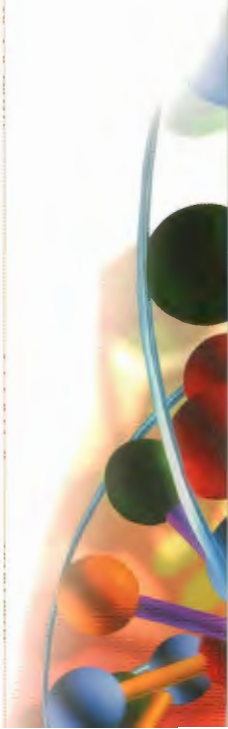


Life Science Discovery & Application

8000 B.C.	Trial and error genetics — domesticated crops and livestock
4000-2000 B.C.	Origins of biotechnology — fermentation of bread, beer, cheese and wine
500 B.C.	Origins of pharmaceutical products — soybean curd to treat boils
1663, 1675 A.D.	Origins of life — Hooke discovers cell; Leeuwenhoek bacteria
1797	Origins of vaccines — Jenner inoculates viral vaccine for smallpox protection
1865	Origins of genetics — Mendel discovers laws of heredity
1879	Trial and error genetics — Fleming discovers chromatin, later called chromosomes
1902, 1906	Origins of immunology — terms of immunity and genetics used
1915, 1919	Phages or bacterial viruses discovered
1928	Fleming discovers penicillin as an antibiotic
1938, 1941	Molecular biology term coined, followed by genetic engineering
1953	Nature publishes Watson and Crick DNA discoveries, heralding the modern era of genetics
1967	Protein synthesizer is perfected
1973	Cohen and Boyer perfect techniques to cut and paste DNA and reproduce in bacteria
1975	First monoclonal antibodies produced
1978-79	Recombinant human insulin and growth hormone synthesized
1980	Patenting of recombinant life forms and gene cloning
1982	First biotech drug FDA approved— human insulin in genetically modified bacteria
1986	First recombinant vaccines for humans — hepatitis B
1988	Congress funds human genome project
1997	First animal cloned from adult cell — Dolly
2002	Complete map of human genome published
2004	NASA discovers previous presence of water on Mars that could support life

Source: Biotechnology Industry Organization: http://bio.org

The Life Science Continuum From Bench to Bedside:

Definition of Life Sciences

The life science industry is a new and rapidly changing industry that does not fit into any of the traditional categories. We define life sciences as a number of industry segments that create a continuum beginning with basic research on human disease and ending in the delivery of services connected to human health – a continuum we refer to as "from bench to bedside." The chain begins with the scientific research and discovery conducted by the federal government, academic institutions and independent research institutes. This research is translated into products and services by the biotechnology, medical device, pharmaceutical and bioinformatics industries. These products and services are, in turn, distributed and sold by the pharmaceutical companies, tested and delivered to patients by the clinical teaching hospitals and community health care networks and financed and reimbursed by the health care insurance companies. All of these industry segments are interrelated by a common commitment to improving human health, but each segment has its own unique and special real estate requirements. This continuum and the amount of economic activity it represents for the U.S. economy is reflected in the chart on the right.

"A great medical institution does more than make history. It makes the *future*."

Dr. Robert M. Glickman
Dean of the New York University School of Medicine

THE LIFE SCIENCE CONTINUUM

LIFE SCIENCE R&D		INFORMATION-BASED AND MEDICINE AND HEALTHCARE MANAGEMENT		BIO-PHARMACEUTICAL BUSINESS			INSURANCE BUSINESS
Basic Research and Discovery	Development	Clinical Trials	Patient Diagnostics & Treatment	Point of Care/ Administration	Manufacturing	Sales/ Marketing/ Distribution	Payment
$8B	$14B	$22B	$40B	$40B	$12B	$20B	$15B

Source: Goldman Sachs, Life Science Update, 2003, www.idc.com

By necessity, this first volume of Alchemy focuses on a limited portion of this broad continuum – namely, the interface among research and development, the commercial segment of the market *(biotechnology, medical device and pharmaceuticals)*, and the clinical teaching hospitals, with a specific focus on the lab market in each of the nine life science "clusters" and emerging clusters. In future volumes of Alchemy, the full spectrum of the continuum of life sciences will be covered.

DRIVERS OF THE LIFE SCIENCE REAL ESTATE INDUSTRY

DEMOGRAPHICS: AGING POPULATION WITH INCREASING HEALTH CARE NEEDS

In the United States, the older population *(persons 65 years or older)* numbered 35.6 million in 2002. They represented 12.3% of the U.S. population, about one in every eight Americans. By 2030, this number is expected to double and reach about 71.5 million older persons, representing 20% of the population.[1] As this aging population increases, health care needs will grow simultaneously because older patients are more likely to suffer from chronic diseases and need more expensive medical care.

RISING HEALTH CARE COSTS

The United States spends a larger share of its gross domestic product (GDP) on health care than any other major industrialized country and health care expenditures continue to be one of the fastest growing components of the Federal budget. In 1960, health care expenditures accounted for about 5 percent of the GDP; by 2000, that figure had grown to more than 13 percent. Although the rate of growth in health care costs slowed somewhat in the mid-1990s, it has once again started to rise at a rate that exceeds other sectors of the economy. Thus, identifying ways to contain health care costs and obtain high value for our health care investments continues to be a priority for the United States. Advances in science promising new cures and treatments for chronic disease and a new personalized approach to medicine can help to reduce health care costs. Thus, the demand for scientific and healthcare facilities where these activities take place will remain high.[2]

[1] *Department of Health and Human Services, Administration on Aging website*
[2] *Agency for Healthcare Research and Quality, www.ahrq.gov*

Public/Private Investment in The Life Science Industry

Public and private investment in the knowledge and technologies needed to improve human health over the last decade has been enormous and unprecedented. NIH research funding increased by 128% from 1992 to 2002 representing $130 billion in total funding.[3] Although the rate of increase is likely to slow, new initiatives such as Bioshield and the NIH Roadmap will ensure this public investment continues. Private investment has been increasing as well. In spite of the difficulties in the public capital markets, venture capitalists invested $18.8 million in private life science companies between 1998 and 2003, representing an 85% increase.[4] All of this activity has spawned new research groups and companies, driving the demand for life science space. Since spending on research facilities has not kept pace with increases in research funding, shortages of space, particularly at academic and medical institutions, have emerged.

Revolutionary Scientific Advancement

Announced in June, 2000 by President Clinton and Prime Minister Tony Blair, the mapping of the human genome represents arguably the most significant scientific discovery of the twenty-first century. For the first time, scientists have the blueprint for how the human body operates. The next challenge will be to convert this information into new diagnostic tools, vaccines and therapies that will improve human health and dramatically increase the life expectancy of the general population. Research into these areas will continue and increase.

Changing Nature of Science

Entirely new types of research facilities will be needed to keep pace with today's rapid rate of change in the biomedical sciences. Future research will require larger, multi-disciplinary and interdisciplinary teams of scientists working closely with clinicians to produce new treatments and drugs. Modern facilities that encourage interaction and are equipped to facilitate communication will be needed for this work. In addition, many emerging disciplines and technologies require new types of specialized facilities, such as biocontainment laboratories for handling infectious agents or clean rooms for producing clinical-grade gene vectors. As a result, facilities once expected to last for two or three decades can become technologically obsolete in less than half that time.[5]

Shortages of Institutional Life Science Space; Obsolete Facilities

The U.S. has more than 900 biomedical research-performing institutions, including 617 academic institutions *(colleges, universities and medical schools)*, 171 nonprofit research organizations and 125 research hospitals.[6] Much of the biomedical research infrastructure at these organizations was built 30 or more years ago, when the Federal government committed major financial resources to direct grants for research facilities and must be upgraded or replaced.

According to a report, *Scientific and Engineering Research Facilities at Colleges and Universities, 2002,* released by the National Science Foundation, 29 million square feet of new research space will be needed to meet academic needs and 33 million existing square feet of research space needs major renovation. More than half of the institutions that conduct biological or medical research have inadequate research space to meet their current research commitments. Of these institutions,

- 64% of biological science institutions have inadequate amounts of space, and
- 70% of medical science institutions have inadequate amounts of space.

Consequently, the amount of research space projected to be under construction at research-performing institutions increased to 16.1 million square feet in fiscal year 2000-2001, a 70% rise from construction starts in 1994-1995. The amount of financing dedicated to new construction was $1.7 billion in 1998-1999 compared to $399 million in 1994-1995. New repair and renovation projects begun in 1996-1997 are expected to upgrade 16.4 million square feet, or about 11% of existing research space.[7]

The Need for Private Life Science Space

All of the developments and activity described above have spawned a vibrant private life science industry. In April, 2003, the market capitalization of publicly traded biotechnology companies had reached $206 billion. Life science companies launched nearly 150 products in the market with another 1,000 in the pipeline. Despite the potential for some consolidation, industry fundamentals are sound and will ensure continued private demand for new space in order to meet the changing nature of science and new regulatory frameworks.

[3] *National Institutes of Health: Office of Extramural Research, http://grants.nih.gov/grants/awards/awardtr.htm*
[4] *Pricewaterhouse Coopers MoneyTree Survey Historical Trend Data, http://pwcmoneytree.com*
[5] *A Report to the Advisory Committee of the Director, National Institutes of Health, by NIH Working Group on Construction of Research Facilities, July 6, 2001.*
[6] *NIH Working Group on Construction of Research Facilities: A Report to the Advisory Committee of the Director, National Institutes of Health, July 6, 2001.*
[7] *National Science Foundation Survey of Science and Engineering Research Facilities at Colleges and Universities, 1998.*

THE "GEOGRAPHIC CLUSTERING" EFFECT

The explosive growth of the life science sector, fueled by public and private investment over the last ten years, with its promise of high wage employment has prompted 83% of economic development officials to turn their attention to developing the industry within their states.

The desired result may not be as easy to obtain as it would appear. Economic activity in this industry tends to "cluster" in areas with major academic institutions that receive NIH funding, where venture capital is plentiful and where scientists and Ph.D.s want to live.

There are ten basic ingredients essential to the emergence and growth of these types of clusters:

- **National Government Support: Finance Basic Research**
  A combination of public and private investment over a period of time lays the foundation for life science development. Public investment must come first, in the form of grants from the National Institutes of Health. NIH funnels this investment through leading research universities and independent research institutes in order to improve the odds that research dollars will result in discoveries that improve human health.

- **Leading Research Universities: Perform Basic Research**
  Leading research universities, in turn, use government grants to perform the basic research that will support future drug candidates.

- **Strong, Collaborative Scientific Relationships**
  In order to accomplish this, scientists within these universities must work collaboratively across institutional boundaries to share information and insights. The need for proximity in this work results in the "clustering" of groups of scientific teams and emerging companies.

- **Successful Technology Transfer**
  In order for public investment to be translated into commercial value, the intellectual property associated with the underlying technology must be protected by patent and then transferred by license to private companies. Strong technology transfer efforts lay the foundation upon which commercial value can develop.

- **Risk Taking Culture, Both Within Scientific Institutions and Community**
  Entrepreneurial scientists and managers, who understand the steps required to translate the discoveries of basic research into commercially-viable products, must be willing to take the risk of staking their careers on the foundation, growth and development of a successful biotech enterprise.

- **Private Capital to Finance Further Development of Promising Drug Candidates**
  It now takes fifteen years and $800 million to successfully launch a new drug candidate. Managers and scientists must establish relationships with venture capitalists who understand the science and the market and are willing to invest their money in pursuit of improved human health. Similarly, big pharmaceutical companies provide additional financial support as they search for partnerships that will supplement their drug pipelines.

- **Quality of Life: Location and Amenities**
  In order to ensure that new companies will stay and grow in a given area and won't move elsewhere as their employment base increases, a geographic area must have the intangible qualities that encourage people to stay. These include affordable housing, strong schools, a supportive climate in which to raise families and an intellectually vibrant culture.

- **Skilled Workforce: Scientists and Support Services**
  As companies grow and develop, they will need a steady stream of talent to advance their research and commercial opportunities. The presence of universities granting life science degrees, especially Ph.D.s, and technical schools offering certification programs for laboratory support services provide the pool of labor required to keep the sector strong.

- **State and Local Government Support: Corporate Incentives**
  Public investment in the infrastructure needed to support this industry, as well as location incentives that offset some of the risk of development fuel the continued economic growth of these areas.

- **Established Industry Base and the Presence of "Big Pharma"**
  Finally, the continued presence and growth of biotechnology companies, supported by the presence and financial muscle of big pharmaceutical companies, ensures that an emerging life science cluster will endure.

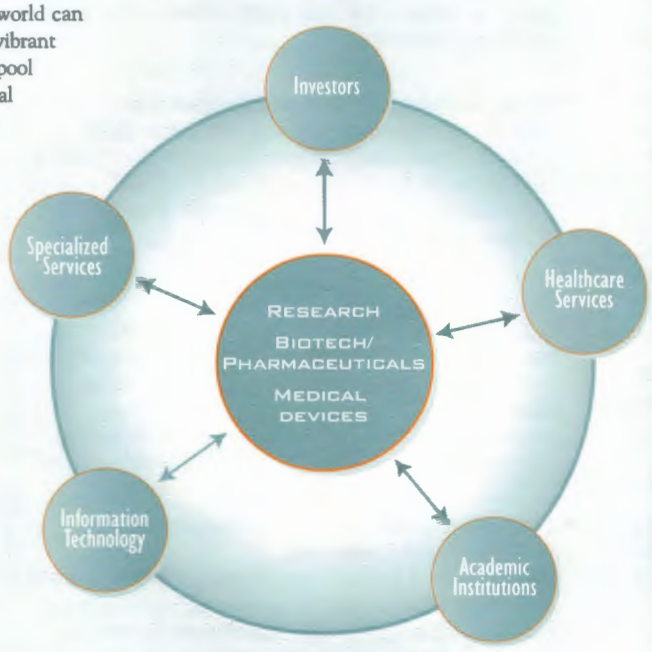
Given the complexity, risk and time required for the development of life science clusters, it is not surprising that a finite number exists throughout the country. According to the Brookings Institution, nine metropolitan areas represent key clusters in the country and dominate biotechnology research activity and commercialization. These areas include: Boston, New York-New Jersey, Philadelphia, Washington DC-Baltimore, Raleigh-Durham, Los Angeles, San Diego, San Francisco and Seattle. Collectively, they account for more than three-fifths of all NIH spending on research; for slightly less than two-thirds of all biotechnology related patents; for eight of every nine dollars in life science venture capital; and for 95% of the dollars in research alliances. These nine clusters will continue their leadership in the growth of the life science industry.[8]

Since the release of this information, however, in these regions several secondary or emerging "clusters," have developed, including Houston, Texas, Indianapolis, Indiana, Memphis, Tennessee and Chicago, Illinois, that are gaining ground as fertile life science centers. The attributes that have catalyzed these emerging clusters are covered later in this report.

Case Study: Greater Boston
Not Just A Cluster, But A "Super Cluster"

Greater Boston is blessed with resources in life science research, development and commercialization that few other places in the U.S or the world can match. This wealth of resources is bolstered by the region's vibrant biotech, pharmaceutical, and medical device industries, a large pool of life science-related venture capital funds, and sizable medical practitioner community. The chain of life science innovation in the region, measured from lab bench to bedside, can often be measured by a few steps – and when taken together, Greater Boston's life science firms, its researchers, and its financiers comprise a veritable Life Science "Super Cluster."

All of this activity has positioned Greater Boston and Massachusetts well for growth in new markets previously unrelated to life sciences. For example, Greater Boston, with its deep roots in computer science research and in the Information Technology (IT) industry, is serving as a center for the development of new tools that researchers are using to analyze genomic data for insights that will lead to the development of new and more effective drugs. For example, the emerging field of bioinformatics applies advanced computational techniques and IT to data generated by genomic research to yield new targets for drug development. Nanotechnology promises to revolutionize medical treatment by creating drugs and devices that operate on a molecular scale. Greater Boston's historic strengths in materials research, computer science, and other fields have given the region an early lead in the race to claim leadership in emerging nanotechnology-related industries.



[8] *"Signs of Life: The Growth of Biotechnology Centers in the U.S.," by Joseph Cortright and Heike Mayer, The Brookings Institution Center on Urban and Metropolitan Policy, 2002.*

Source: "Index of the Massachusetts Innovation Economy:" Massachusetts Technology Collaborative 2002.

CREATING THE INFRASTRUCTURE: CHALLENGES OF THE LIFE SCIENCE REAL ESTATE INDUSTRY

The life science industry, more than some other industry sectors, requires a specialized infrastructure - buildings, equipment and personnel - to provide the foundation for its activities. This infrastructure plays an important role, not only in productivity of life science personnel *(stimulating the best and most creative thinking)*, but also in enabling and protecting the work that must be done to create, produce and deliver new drugs and treatments to improve human health. For example:

- To conduct biomedical investigations, scientists depend on access to specialized facilities such as laboratories that meet certain structural, safety and scientific requirements, clinical research environments where human subjects may be studied, and animal facilities suitable for maintaining the health and well-being of laboratory animals.

- In order commercialize the results of discovery, biotechnology and pharmaceutical companies require manufacturing facilities *(both pilot and scale-up)* where new drugs and treatments can be produced.

- Finally, in order to deliver the new drugs, treatments and therapies to patients, clinical teaching hospitals and community hospitals need accessible, state-of-the-art clinical environments, where patients are comfortable and physicians can deliver quality care.

Building and maintaining this infrastructure is not an easy task, however. Several challenges confront the users, developers and owners of life science real estate for the following reasons.

LIFE SCIENCE INDUSTRY FUNDAMENTALS ARE DIFFERENT

The life science industry trades on expectations of future developments, not profitability. The cost of research, development and commercialization of new products is high. It takes years to bring these products to market. Consequently, the majority of more than 4300 publicly traded and privately held companies are loss making enterprises.

This means that most most life science enterprises are not credit-worthy tenants, lacking the profitability to support financial instruments to finance buildings. In addition, most of the organizations that conduct federally sponsored biomedical research are not-for-profit universities or research institutions. Without the profit margins of commercial businesses, these organizations lack access to additional capital for facility construction as the volume of research grows. Although some institutions are positioned financially to absorb the costs of building or modifying research space, institutions of all types and sizes encounter obstacles when trying to create the facility infrastructure for their work.

Lenders must conduct specialized underwriting criteria, evaluating the location of a facility and the science being conducted by tenants in order to evaluate the risk of financial investment in real estate for this industry.

REAL ESTATE PRODUCT IS DIFFERENT

As described in the next section of this report, life science real estate facilities are complicated and expensive structures to build and maintain. The structural, zoning, permitting and operational requirements are unique and require specialized knowledge, licenses and certifications for organizations and individuals developing and running this real estate product.

ANALYSIS IS A SPECIALIZED SUBSET OF GENERAL REAL ESTATE STATISTICS

The relative newness of this industry and the unique characteristics of the life science product and market means that little information is available to assess the demand, availability and vacancy rates in all kinds of space in the life science real estate marketplace. Often, the value of a facility will be affected not only by local market conditions, but the national market as well, and the type of activity or science being conducted within it. Decision makers at life science companies often find it difficult to obtain meaningful information when making decisions about a critical and costly investment that may make the difference between the success and failure of their efforts. This report represents a first step in addressing this lack of knowledge and data.

Creating the Infrastructure:
Characteristics of Life Science Real Estate

Life science space is qualitatively different from office space. The required structural characteristics and the strict environmental and safety restrictions coupled with the hybrid nature of space required by hospitals and lab tenants, make new construction highly-specialized and an integral part of the clinical delivery and scientific discovery process. The additional amenities and physical characteristics required dictates that these buildings generally command a much higher price per square foot than office space. Construction costs can range from $175 to $500 per square foot. Tenant improvement costs can range from $75 to $200 per square foot.

Lexicon Genetics / The Woodlands, TX

3500 Paramount Parkway / Morrisville, NC
61,603 square foot laboratory building

The following describes some characteristics that differentiate life science facilities from general commercial properties.

- **Lab to Office Space Ratio:** Most lab facilities include a split of 60% lab and 40% office use on a floor-by-floor basis. Additionally, new life science facilities are offering multiple common areas such as lounges and cafés, where researchers can meet, discuss, and collaborate.

- **Building Services:** Special consideration must be made for the proposed research in each respective building, including an evaluation of the chemicals that will be stored and transported and how biological waste will be disposed.

- **HVAC:** Sufficient air circulation is critical to life science users and required ventilation systems must be worked into the base building upgrades.

- **Electrical:** The electrical design criteria for a state-of-the-art research facility have skyrocketed as science and technology have become interdependent. The power grid must be capable of supplying the appropriate electrical capacity for augmented HVAC requirements, research data and scientific analysis tools.

- **Clear Height and Structure:** Sufficient clear height for fume hoods and exhaust is essential. Additionally, concentrated equipment and workbench areas in lab buildings require heavy loading.

- **Vertical Shafts:** A life science building must contain ample vertical space for supplying sufficient air and removing the exhaust fumes of any biotech user, without over burdening cost or compromising the function of the space.

- **Lab Module:** An efficient lab planner must identify critical lab space requirements such as bench layouts.

- **Acoustics, Air Quality, and Vibration:** The potential for vibration from equipment and the street environment to effect sensitive lab experiments is a key factor. Often, building adjustments must be made to prevent such vibrations from occurring.

- **Zoning:** Zoning restrictions and other state and federal regulations can inhibit or prevent use changes, the handling of hazardous materials and the ability to locate equipment or systems on the tops of buildings.

- **Flexibility:** The only thing certain in life science space is change. Every floor of each building should be built with its own infrastructure so that all the air, electric wiring and plumbing can be easily modified and office space turned into lab space or clinical space if necessary.

Design Criteria	Building Services
90-100% Fresh Air	Elevator size/capacity
60/40 Split: Lab/Office Space per Floor	Delivery Loading and Shipping
HVAC: Min 2.0 cfm/sf at Labs; Min 1.2 cfm/sf at Support Areas	Chemical Storage
25 - 40 Watts psf of Power	Emergency Power
Clear Height: 13'-16' floor-to-floor	Redundant Systems
Core/Wall Dimension	Lab Waste Treatment
Lab Module	Utility Upgrades
Lab and Fume Hood Exhaust	Penthouse and Screening for Roof Top Equipment
Acoustics	Emergency Procedures
Air Quality	Security
Vibration	
Vivarium Space	

Source: National Institutes of Health Guidelines, April 2002.

- **Biosafety Levels:** In addition to the characteristics described above, each life science facility must meet certain standards for biosafety depending upon the type of research being conducted. Regulations as to safety and security requirements and licenses for buildings vary depending upon this research.

Classification of Biohazardous Agents by Risk Group	
Risk Group 1 (BSL1)	Agents that are not associated with disease in healthy adult humans
Risk Group 2 (BSL2)	Agents that are associated with human disease which is rarely serious and for which preventive or therapeutic interventions are often available
Risk Group 3 (BSL3)	Agents that are associated with serious or lethal human disease for which preventive or therapeutic interventions may be available (high individual risk but low community risk)
Risk Group 4 (BSL4)	Agents that are likely to cause serious or lethal human disease for which preventive or therapeutic interventions are not usually available (high individual risk and high community risk)

Source: Basics for the Classification of Biohazard Agents By Risk Group

Life Cycle of a Life Science Enterprise

The drug-development value chain can be divided into four basic steps: research in which promising compounds to treat a particular disease are identified; development, where the compound is refined and tested in clinical trials in animals and humans; manufacturing, where the compound is produced in large quantities; and commercial, including activities such as sales and marketing.

The Drug Development Value Chain

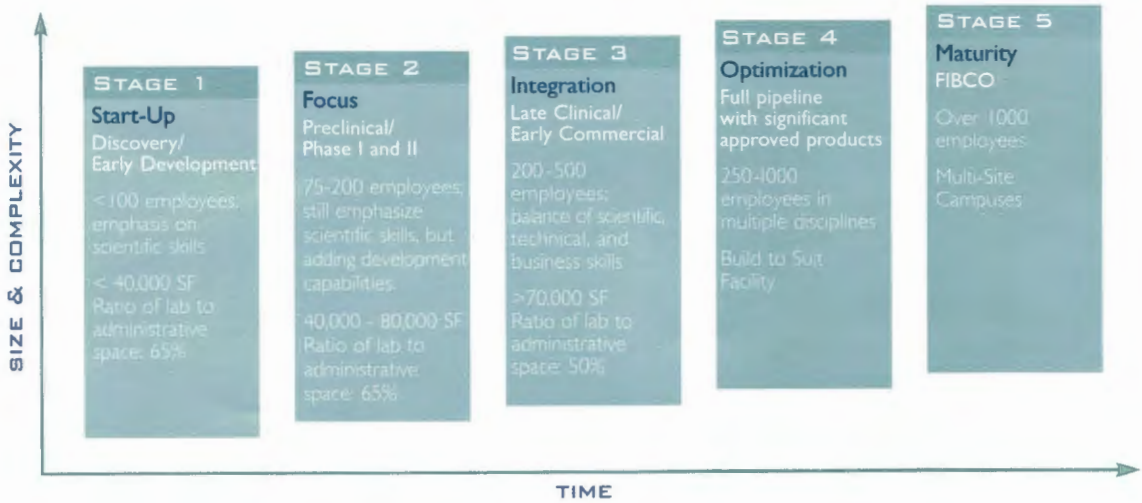
Government Oversight

Research	Development			Manufacturing	Commercial
	Pre-clinical	*Clinical*	*FDA review*	→ *FDA Approval*	
Company and academic researchers find an innovative way to treat disease.	Companies test product candidates in animals to determine if one is suitable to test in humans.	Company tests product in patients to determine if it is safe and effective as a potential treatment.	The U.S. Food and Drug Administration *(FDA)* analyzes the testing results to determine if the product is safe and effective for its intended use.	Company uses complex processes to manufacture sufficient product quantities.	Company shares information about product with patient groups and with doctors, who prescribe treatment for patients.

Drug development is a complex process taking up to 15 years and costing roughly $800 million.

Source: MassBiotech 2010: "Moving Down the Drug Development Value Chain"

Each section of this value chain poses a different set of considerations for a life science company in choosing to locate to a particular area. For example, a company engaging in research may choose a location based on the combination of the amount of funding and investment activity there is in the region, and the availability of an educated labor pool. A company engaged in initial development and pilot manufacturing might gravitate toward areas that are surrounded by research facilities. An entity conducting clinical trials may choose to locate in an area in which there is a concentrated presence of accomplished clinical investigators and leading research hospitals. At the manufacturing stage, companies need to find facilities that are less costly, while still providing access to drug development resources. Finally, a company that has reached the commercial phase of development needs to locate itself globally to handle the distribution and regulatory challenges of bringing the product to market.



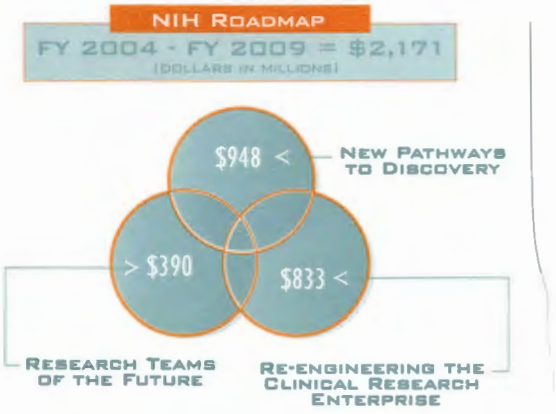
Source: "Creeping Over the Chasm: Biotech's Perilous Managerial Transitions," Walter E. Mardis and Jeffrey B. Aibel, Mardis, Aibel & Associates; In Vivo: The Business and Medicine Report, December 2003.

WHAT'S NEW

THE CHANGING FACE OF BIOMEDICINE: THE NIH ROADMAP FOR MEDICAL RESEARCH[9]

The spectacular advances in science during the last decade have set the stage for even greater advances in the quest to improve human health for the future. Realizing this promise will require new ways of working amongst larger, multi-disciplinary and inter-disciplinary teams of scientists in biology, chemistry, physics, mathematics, engineering, computer science and information technology.

NIH plans to invest over $2 billion over the next five years in a Roadmap for Medical Research designed to "produce a more efficient, innovative and productive system of biomedical and behavioral research."[10] The Roadmap aims to: accelerate the pace of discovery in life science through novel approaches to drug development that might be more effective and reduce costs; translate this research more quickly to patient delivery in order to speed drug development application from bench to bedside; and establish effective feedback mechanisms so that patient data can be used more extensively in the research process.



NEW PATHWAYS TO DISCOVERY

Human disease often results from the complex interaction of genes, behavior, diet and nutrition, infectious agents, the environment and the social setting. In order to ensure that appropriate resources are available to all scientists attempting to understand this complex interaction, NIH will facilitate the provision of novel enabling technologies. These include, among other things:

- The creation of national technology centers for networks and pathways,
- Expansion of molecular probe libraries and molecular imaging capabilities, and
- National centers for biomedical computing where data can be shared and analyzed using a common set of software tools.

RESEARCH TEAMS OF THE FUTURE

The scale and complexity of twenty first century research requires new organizational models. NIH's Roadmap will preserve the traditional investigator-led approach, but with multi-disciplinary research teams that will coordinate their activities and share data and resources. NIH has established:

- Planning grants to design and construct interdisciplinary research centers,
- Education and training incentives for interdisciplinary translational research, and
- Public/private partnerships aimed at removing business practices that impede interdisciplinary research.

RE-ENGINEERING THE CLINICAL RESEARCH ENTERPRISE

The Roadmap also presents a new vision of "translational medicine" that will create more effective feedback mechanisms and closer connections between researchers and clinical delivery. To facilitate the development of translational medicine, NIH plans to:

- Form "communities of research" amongst patients, physicians and scientists through a National Electronic Clinical Trials and Research *(NECTAR)* Network,
- Create regional translational research centers with specialized core research services *(in pharmacology, immunology, transgenics, microarray, bioinformatics)* accessible to all scientists, and
- Develop a publicly available Patient-Reported Outcomes Measurement Information System *(PROMIS)*.

The NIH Roadmap will help to realize the social return on the huge public investment in improving human health over the last decade, as well as to address new challenges in the health care environment such as aging, chronic conditions, disparities across gender and race, emerging strains of infectious disease and the real possibility of bioterrorism.

[9] *NIH Roadmap Initiatives, http://nihroadmap.nih.gov/initiatives.asp*
[10] *"The NIH Roadmap for Medical Research," Elias A. Zerhouni, M.D., February 27, 2004*

TRANSLATIONAL MEDICINE: ACCELERATING DISCOVERY FROM BENCH TO BEDSIDE[11]

Translational medicine attempts to link more closely the research bench with clinical delivery at bedside in order to speed the drug development process and to explore innovative approaches to treatment and prevention. This approach requires new facilities, such as the one described below, that can house research and clinical delivery activities, as well as public/private partnerships, all serviced by core service centers.

THE NEW YORK-PRESBYTERIAN CENTER OF EXCELLENCE IN TRANSLATIONAL MEDICINE

The New York-Presbyterian Center of Excellence in Translational Medicine in White Plains, New York, will be a 386,000 square foot facility, the major theme of which will be collaboration and partnering. In this new building, researchers and clinicians from New York Presbyterian Hospital will share a majority of the space with researchers from affiliated academic institutions such as Weill Cornell Medical College and Columbia College of Physicians & Surgeons. The remaining space will be leased to private companies doing applied research, translating the basic science done by the academic researchers at the Center of Excellence into new therapeutic products and treatments. The building will have a clinical delivery component as well.

Four core centers will provide cross-disciplinary services, tools and technologies to the researchers at the Center of Excellence in order to further advance the collaborative cross-industry research.

- The "Center for Information Based Medicine" will provide the most advanced computer and information technology base capability anywhere in the state and Northeast region, facilitating work in biomedical informatics, nanotechnology, and neurology. IBM and Affymetrix are partnering with the Hospital to build and run this Center.
- An advanced "Transgenics Center" will supply researchers at the Center of Excellence and throughout the region with genetically modified animals for their work, facilitating the process of conducting clinical trials.
- An "Imaging Center," created by the Hospital in partnership with General Electric, will focus on advancing molecular level research in both human and animal studies. The Center will provide a unique opportunity to combine imaging and interventional radiology for a complete approach to patients and to the discovery of new cures.
- A state-of-the art "Genomic Analysis Center" will also be created to provide whole genome expression profiling and phenotyping in support of the human and animal studies in all disease areas. These services allow researchers to understand the physical effects that result when genes are altered.

TRANSLATIONAL MEDICINE

Total initial program costs will be approximately $230 million, which will include multi-million dollar support from the State of New York. The Hospital estimates that the program will generate 950 high tech jobs, and 1,422 construction jobs, as well as $240 million in annual economic activity in the City of White Plains and Westchester County, New York.

[11] *Release from New York Presbyterian Hospital*

REDUCING THE COST OF DRUG DISCOVERY & DEVELOPMENT: REDESIGNING FACILITIES FOR PHARMACEUTICAL MANUFACTURING

Pharmaceutical manufacturing techniques have not kept pace with modern, "continuous" production processes used in other industries. This inefficiency is costing the U.S. consumer of health care dearly. According to one industry expert, the top 16 drug companies spent $90 billion on manufacturing in 2001, accounting for 35% of the industry's costs – more than double the share of research and development and almost as much as the 41% devoted to marketing and administrative costs.[12]

In the future, pharmaceutical manufacturing will play an increasingly important role in speeding the delivery of safe drugs to market and reducing the cost of health care. In order to do this, pharmaceutical companies will need to build new manufacturing facilities that are more flexible in design and innovate using cutting edge scientific engineering knowledge and the best practices of quality management.

Historically, the FDA has overseen the manufacture of drug products using a two-pronged approach involving review of information submitted in applications as well as inspection of manufacturing facilities for conformance to requirements for Good Manufacturing Practice *(cGMP)*. As part of the drug approval process, the FDA must review a company's manufacturing plant and a detailed manufacturing plan for the proposed drug. After approval, even small changes triggers another round of bureaucratic review and authorization. Consequently, many companies are slow to introduce new manufacturing changes, wary that the consequent production delays will mean further delay and higher costs.

In addition, pharmaceutical manufacturing can be slow, costly and more prone to error than in other industries. Conventional pharmaceutical manufacturing is generally accomplished in many separate steps using batch processing with laboratory testing conducted on hand collected samples to ensure that the batch meets the standards for stability and quality. Factories often sit idle during these time periods.

Fortunately, progress is being made to reduce the cost and uncertainty of manufacturing drugs. In August, 2002, the FDA launched a new initiative entitled Pharmaceutical cGMPs for the 21st Century. The initiative contains three broad approaches.

- The new FDA initiative would minimize the number of production changes requiring advance approval, limiting its oversight to those areas where quality is threatened and patient health might be compromised.
- A scientific, risk-based framework called Process Analytical Technology *(PAT)*, aims to encourage manufacturers to develop and implement new tools for development and manufacturing while maintaining the current level of product quality and safety. The goal of PAT is to build in quality by design in the manufacturing process rather than by testing.
- The new framework also creates a team of inspectors that handle only pharmaceutical plants, thereby fostering relationships between the regulators and regulated and ensuring the expertise of those responsible for enforcement.

Regulatory policies can and must continue to encourage this transformation in order to ensure that the world realizes the financial and personal return on investment made to transform human health over the last two decades.[13]

***Genzyme World Headquarters** / Boston, MA*

[12] *The Wall Street Journal, September 3, 2002, "Factory Shift: New Prescription For Drug Makers: Update the Plants — After Years of Neglect, Industry Focuses on Manufacturing; FDA Acts as a Catalyst — The Three Story Blender", by Leila Abboud and Scott Hensley.*

[13] *Pharmaceutical Industry Profile 2003, Pharmaceutical Research and Manufacturers of America.*

Sources: FDA Guidelines, Pharmaceutical cGMPs for the 21st Century: A Risk-Based Approach, Summary Progress Report, FDA Guidelines, Pharmaceutical cGMPs for the 21st Century: A Risk-Based Approach, Draft Guidance for Industry, FDA Guidelines, PAT – A Framework for Innovative Pharmaceutical Manufacturing and Quality Assurance

BIOSECURITY:
WAGING WAR ON BIOTERRORISM AND INFECTIOUS DISEASE

The life science industry creates peaceful applications of new scientific technology to improve human health. Nevertheless, the exposure of American citizens to Bacillus anthracis spores delivered in the U.S. mail after September 11, revealed a gap in the nation's overall preparedness against bioterrorism.

President Bush has proposed a 10-year, $6.0 billion program called "Project Bioshield," designed to protect the country against biological threats. This will include $1.4 billion to be spent by the National Institutes of Health *(NIH)* and $1 billion distributed by the U.S. Department of Health and Human Services targeted toward the States.

Project Bioshield would give federal health agencies wide latitude to expedite anti-terrorism projects, including,

- Initiating research and funding for the stockpiling of promising drugs and vaccines against possible bioterrorist agents such as anthrax, ebola, plague, smallpox, botulin *(the neurotoxin responsible for botulism)*;
- Supporting scientists with specific expertise in bioterrorism, streamlining contracts; and
- Building specialized laboratories at the Biosafety Levels (BSL)-3 and 4 which have the containment safeguards necessary for the secure study of potentially lethal agents as well as the preclinical testing of vaccines and drugs.

Until now, an insufficient amount of laboratory space at the BSL-3 and -4 levels, has hampered the biodefense research agenda. Only four BSL-4 laboratories exist in the United States today.

Project Bioshield will help to change that. NIH is currently constructing or plans to construct new BSL-3 and -4 laboratories at its Fort Detrick and Rocky Mountain Laboratories, and BSL-3 laboratories at the NIH campus in Bethesda, Maryland.

In addition, over the next several years the National Institute of Allergy and Infectious Disease *(NIAID)*, together with its academic partners, will finance the construction of two BSL-4 National Biocontainment Laboratories *(NBLs)* and ten BSL-3 Regional Centers of Excellence for Bioterrorism and Emerging Disease Research *(RBLs)* throughout the country. These facilities will also include clinical areas for isolation and study of patients exposed to bioterrorism agents.

One-time grants of $120 million will fund the construction of the NBLs and one-time grants of between $7 and $21 million will fund the construction of the RBLs. Each academic institution will be required to provide matching funds.

According to NIAID, "The overall objective of the NBL construction program is to provide funding to design, construct and commission comprehensive, state-of-the-art BSL-4, BSL-3 and BSL-2 laboratories, as well as associated research and administrative support space; the RBL construction program will provide funding for similar facilities containing BSL-3 and BSL-2 labs. The BSL labs will be designed and built using the strictest federal standards, incorporating special engineering and design features to prevent microorganisms from being released into the environment. Numerous safety and decontamination features provide multiple layers of protection for lab workers and the surrounding environment." [14]

[14] *Press Release dated September 30, 2003, NIH News, National Institutes of Health.*

Such designation also brings millions of dollars in research funding to scientists working within these centers. Each facility will develop a specialized area of expertise important to product development such as: diagnostic development and validation, small and large animal model development, immunotherapeutics and host/pathogen interactions.

INSTITUTION (LOCATION)	CONSTRUCTION (LOCATION)	PRINCIPAL INVESTIGATOR
NATIONAL BIOCONTAINMENT LABORATORIES (NBLS)		
Boston University	Boston University Medical Center	Mark Klempner, M.D.
University of Texas Medical Branch at Galveston	University of Texas Medical Branch at Galveston	Stanley Lemon, M.D.
REGIONAL BIOCONTAINMENT LABORATORIES (RBLS)		
Colorado State University *Fort Collins*	Foothills Campus, Fort Collins, CO	Michael Dockter, Ph.D. Science Center
Duke University *Durham*	Duke University Medical Center	Anthony Frank, D.V.M., Ph.D.
Tulane University *New Orleans*	Tulane National Primate	Russell Joffe, M.B.
University of Alabama *Birmingham*	University of Alabama *Birmingham*	Joe Kornegay, D.V.M., Ph.D. College of Veterinary Medicine
University of Chicago	Argonne National Laboratory	Arthur Levine, M.D.
University of Medicine & Dentistry of New Jersey *Newark*	University of Medicine & Dentistry of New Jersey	Richard Marchase, Ph.D. School of Medicine
University of Missouri *Columbia*	University of Missouri *Columbia*	Paul Whelton, M.D., B.Ch., B.A.O Research Center, Covington, LA
University of Pittsburgh	University of Pittsburgh	R.S. Williams, M.D.
University of Tennessee *Memphis*	University of Tennessee Health	Thomas Rosenbaum, Ph.D.

Source: "NIAID Funds Construction of Biosafety Laboratories," Press Release dated September 30, 2003.

These facilities will also serve as national resources for the study of other infectious diseases such as SARS, the West Nile Virus, Ebola and HIV/AIDS which require specialized biocontainment laboratories for research. Thus, these biosecurity efforts will also help to improve the health of people around the world through the development of interventions for emerging and re-emerging infectious diseases.

SPREADING THE WEALTH:
STATE INITIATIVES TO PROMOTE LIFE SCIENCES

The Scripps Research Institute *(TSRI)*, one of the country's largest, private, non-profit research organizations, stands at the forefront of basic biomedical science, with a scientific strategy that encompasses three major activities:

- Basic Research
- Multidisciplinary Approach to Problem Solving/Collaboration
- Perpetuation of Knowledge Through Education and Training

TSRI has become internationally recognized for its basic research into immunology, molecular and cellular biology, chemistry, neurosciences, autoimmune diseases, cardiovascular diseases and synthetic vaccine development.

The Institute's staff now includes more than 270 professors, 800 postdoctoral fellows, 1500 laboratory technicians, administrative and support personnel, and 126 Ph.D. students. Its faculty include three Nobel Laureates and numerous members of the National Academy of Sciences, the National Institute of Medicine and the American Academy of the Arts and Sciences. Many have won prestigious scientific awards.

Its campus in La Jolla, California contains more than 1.0 million square feet of laboratory space, which include some of the most advanced instruments and capabilities in bioinformatics and computational biology and are designed to encourage collaboration and achievement in pursuit of TSRI's mission.

TSRI has entered into more than 100 technology licensing agreements with numerous biotechnology companies, while maintaining its relationships with large-scale pharmaceutical partners. By some accounts, over 40 emerging companies have been spun out of TSRI's laboratories.

TSRI's achievement's have catapulted the La Jolla, California area into the forefront of biomedical science and provided an economic engine for the region, through the creation of skilled, well-paying jobs in a variety of industries.

Now, the State of Florida and Palm Beach County will partner with TSRI to encourage the Institute to expand beyond its California base and establish a similar catalyst for life sciences on the East coast. Together, they will develop a 364,000 square foot research laboratory facility with support space on a 100-acre campus known as Mecca Farms in North Palm Beach County, which is being planned along with a larger science center by the State and County. When completed, TSRI will occupy the facility, focused on biomedical research, technology development and drug design.

The goals for this ambitious project are to:

- Provide a state-of-the-art research environment that will attract leading scientists to the Institute.
- Collaborate with and support local industry, businesses, the university system, and school districts within the region.
- Provide a campus and facilities that focus on biomedical research, technology development, and drug discovery.

The new facility could include: chemistry and biology type laboratories, vivarium, specialized laboratory support such as NMR facility, BSL-3 facilities, X-Ray Crystallography, Electron Microscopes, and facilities for automation and robotics. There will also be support space and potentially manufacturing and fabrication facilities.

The start-up costs of Scripps Florida are supported by a one-time $310 million appropriation of federal economic development funds made by the State of Florida at the request of Governor Jeb Bush. Additionally, Palm Beach County is providing an economic package that includes the land, $137 million toward construction of the permanent facility and related costs, and costs for temporary facilities for Scripps scientists. Planning, development, and construction of the new campus are scheduled to begin as soon as contracts are finalized. The campus is expected to open in late 2006.

Source: Scripps Research Institute, www.scripps.edu

As the preceding articles highlighted, the life science industry is healthy and growing. Innovation within the industry continues as illustrated by the remarkable advancements spurred by the definition of the human genome. Today, there are more life science companies *(approximately 4,300 worldwide)*, more biotechnology companies are profitable and revenues worldwide continue to increase. These companies have brought 187 new medicines to market, serving more than 325 million patients, with nearly 1,000 new products in the development pipeline. The industry is rapidly moving toward an era of personalized medicine, in which genetic analysis will help physicians diagnose and treat illnesses more effectively by tailoring interventions to genetically defined problem areas. The FDA and NIH are taking steps to speed the time from drug discovery to application, reduce the costs of developing new drugs and encourage new manufacturing processes. Recent governmental initiatives have also encouraged the development of diagnostics, therapeutics and vaccines for biodefense. In many geographic areas, the industry is providing an economic growth engine that is improving public and individual health while generating highly skilled and good paying jobs.

Despite these positive developments, the industry does face some challenges. Ethical issues continue to attract public attention, and the problems of cost and access must be balanced with incentives for innovation that will continue to spawn the discovery and development of new drugs. In addition, the industry is only recently emerging from a prolonged drought in equity financing in the capital markets, prompting consolidation amongst some mid-tier companies and a stronger focus on companies with products in late stage clinical development. The big pharmaceutical companies are also changing the face of the marketplace, forming alliances with smaller companies for the co-development of new drugs in order to replenish their drug pipelines as patents expire on blockbuster drugs which have sustained them for years.

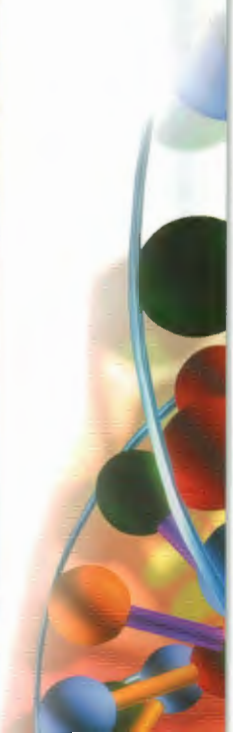
Due to these challenges, the market for life science real estate slowed considerably in 2002 and 2003, after developing quickly in the late 1990s, 2000 and 2001. In many of the life science geographic clusters, availability has increased due to new speculative development as well as a slow down in demand and leasing activity due to consolidation, lack of funding and product failures in many mid-tier companies. Early stage companies must provide expensive letters of credit or some other form of security deposit and owners are less willing to take the risk of fronting high tenant improvement costs which are not recoverable if the company does not survive.

Although certain segments of the market are experiencing difficulty, the outlook for the life science real estate market remains strong, driven by the market need for new and less expensive health care, recent advancements in science, public and private investment over the last ten years that has expanded the number of researchers requiring new life science space and the age and nature of the life science infrastructure that currently exists. Growth of new investor owned space will continue to be hampered, however, by the lack of sophisticated landlords and financial institutions that understand the life science industry's fundamentals and risk profile.

The following section of this report focuses on each of the nine established life science clusters in the United States, gives a brief overview of some emerging clusters and describes a few of the international markets where life science real estate activity is growing. Each of these areas possesses the characteristics outlined previously in this report, but differ according to the level of development of the cluster as well as the core focus of the area *(e.g. research and development, manufacturing, pharmaceutical corporate centers and medical device firms)*.

As expected, rents within these geographic areas also vary depending upon the location, class of space, the degree of lab improvements, the length of the lease time and project scale. Tenant improvement allowances in each cluster depend upon lease terms, the creditworthiness of the tenant and existing conditions in the space. Operating costs can vary as well, depending upon the intensity of the laboratory fit up and the utility usage of a given company. We hope that both investors and users of life science space will find this information and analysis helpful as they consider where to locate operations and how to approach the marketplace.

National Institutes of Health,
Dale & Betty Bumpers Vaccine Research Center
Bethesda, MD



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LIFE SCIENCE Clusters & EMERGING MARKETS

The following section of the report provides overall characterization, supply and demand dynamics, and key trends for more than 70 million square feet in nine major life science clusters, as well as other emerging clusters.

There are certain trends that characterize the national lab market:

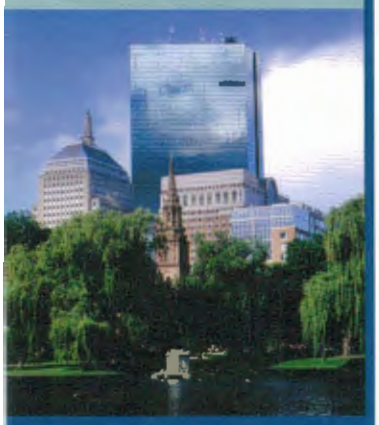
- Location is critical, particularly with respect to proximity to certain industry drivers.
- Supply is constrained in most markets, due to the highly-specialized nature of the facilities.
- Demand for space boomed in the late 1990s, generally declined over the past three years, and is beginning to increase with expectations of future growth.
- Real estate developers and economic development agencies across the country are actively targeting life sciences to bolster their local economies.

The difficulty in identifying lab facilities combined with the vast differences in real estate product types, definitions and scale among geographies made this endeavor challenging. Our methodology was to construct a building-by-building inventory, to the best of our knowledge, of investor-owned[15] commercial lab facilities using Colliers International's local market research in each cluster. Lab facilities were generally defined as any buildings with at least 20,000 square feet, or over 20% wet lab space, including buildings constructed for lab use and any former office, R&D or industrial buildings converted or retrofitted for lab use. Additionally, each market profile details the particular characteristics of the local market that cause it to be a hotbed for the life science industry, as well as major development projects underway or planned that have the potential to change the local lab market landscape. The regional industry and lab market analysis to follow will serve as the foundation for regular reporting and increased depth and breadth of future insight. In some cases, where accurate building square footages were unattainable, statistics were estimated based on life science employment or generally accepted projections.

SPAULDING & SLYE COLLIERS INTERNATIONAL

[15] *Some clusters, where noted, also include corporate-owned and occupied properties.*

BOSTON



DID YOU KNOW?

PHYSICIANS FROM BOSTON WERE FIRST TO:

- USE ETHER AS AN ANESTHETIC IN THE U.S. IN 1846
- DEVELOP NUTRITION-FILLED BABY FORMULA IN 1919
- PERFORM A SUCCESSFUL KIDNEY TRANSPLANT IN 1954
- PROVIDE CLOSED-CIRCUIT TELEVISION FOR SURGICAL PROCEDURES IN 1968
- SPEARHEAD THE MAPPING OF THE HUMAN GENOME IN THE 1990S

Source: "Index of Massachusetts Index Economy," Massachusetts Technology Collaborative 2002

MARKET OVERVIEW

Throughout history, Boston has been recognized as a world leader in conducting breakthrough scientific research, developing innovative medical technologies and delivering superior healthcare. The region has produced a number of research breakthroughs that have driven the life science industry, including five discoveries that have earned Nobel prizes. The complex combination and interaction of scientific research conducted by researchers in large academic medical centers with the work of medical practitioners at the world's leading teaching hospitals and entrepreneurial managers in commercial companies has led to the formation of an economically-strong, dynamic and growing life science "super cluster," which continues to spawn revolutionary advances in medicine and science. The focus of Boston area life science tenants remains scientific research and discovery, not large-scale commercialization, manufacturing or corporate functions.

Boston and Cambridge remain the epicenter of the region's life science activity and 20.2 million square foot lab market, with clusters of life science facilities in core suburban Boston towns along Route 128 and farther out west to Worcester. Boston and Cambridge, combined, account for over 50% of the regional lab market.

INDUSTRY DRIVERS

The Boston area has 13 institutions that grant life science Ph.D.s, three of which are ranked among the top 20 nationally in life science research. Local private universities, such as Harvard University and the Massachusetts Institute of Technology, are the most productive biotechnology patent holders, actively patenting many of their biotechnology innovations. Eleven universities and hospitals in the Boston area are among the top 100 NIH funding recipients, accounting for a total of $1.7 billion in 2002 alone.

MAJOR PLAYERS

Over the years, the region's environment of medical innovation coupled with the presence of eight major research universities in the Boston area – unmatched in any other U.S. region – engendered the formation and a concentration of commercial companies focused on developing new products and processes in the life science industry. Boston has 58 publicly-traded biotech companies with an aggregate market capitalization of nearly $52 billion. The Boston area hosts 33 life science industry firms having more than 100 employees each and more than 100 firms in the area are members of the national Biotechnology Industry Organization *(BIO)*. In the past ten years, many of the world's largest pharmaceutical companies, attracted by the Commonwealth's entrepreneurial environment and critical mass of companies, universities and hospitals, have established basic research facilities in Massachusetts. Novartis and Merck have made significant recent expansion commitments, and many of the top academic and medical institutions continue to grow or to have major real estate expansion needs.

INDUSTRY DRIVERS*

INDUSTRY DRIVERS	TOTAL	RANK**
Life Scientists 1998	>4,900	2
NIH Funding 2002 *(in millions)*	$1,771	1
Venture Capital Funding for Biotech Companies 2003 *(in millions)*	$751	2
Biotechnology Patents *(1990-1999)*	2,162	T4
Number of Biotechnology Companies 2002	252	2

Major Players

Major Institutions

Academic Research/ Medical	Clinical Teaching Hospitals	Independent Research Institutions
Boston University	Beth Israel Deaconess Medical Center	Broad Institute
Harvard University	Boston Medical Center	Dana-Farber Cancer Institute
Massachusetts Institute of Technology	Brigham and Women's Hospital	Joslin Diabetes Center
Tufts University	Children's Hospital Boston	Whitehead Institute for Biomedical Research
University of Massachusetts	Massachusetts General Hospital	
	Tufts - New England Medical Center	

Major Sector Players

Pharmaceutical Companies	Biotechnology Companies	Medical Device Companies
Abbott Laboratories *Worcester*	**Alkermes** *Cambridge*	**Abiomed, Inc.** *Danvers*
AstraZeneca International *Waltham*	**Amgen** *Cambridge*	**Boston Scientific** *Quincy & Natick*
Bayer Diagnostics *Norwood*	**Biogen Idec** *Cambridge*	**Cytyc Corporation** *Boxborough*
EMD Lexigen Research Center *Billerica*	**Dyax Corporation** *Cambridge*	**Epix Medical** *Cambridge*
Merck & Co. *Boston*	**Genzyme Corporation** *Cambridge*	**Millipore** *Billerica*
Novartis Pharmaceuticals *Cambridge*	**Millennium Pharmaceuticals, Inc.** *Cambridge*	**Zoll Medical Corporation** *Chelmsford*
Pfizer, Inc. *Cambridge*	**Vertex Pharmaceuticals, Inc.** *Cambridge*	
Serono, Inc. *Rockland*		
Wyeth *Cambridge*		

Lab Market Snapshot

The Boston area boasts one of the largest commercial lab markets in the nation, with approximately 14.0 million square feet of investor-owned life science research space. An additional owner-occupied component of the market, which is more difficult to quantify because it is not commercially-available, exceeds 6.0 million square feet. Demand for lab space in core Boston clusters reached a frenzied pace in the late 1990s and near-zero vacancy spurred significant build-to-suit and speculative development leading to nearly 50% growth in inventory over the past five years. Availability in the lab market has increased substantially in the last three years due to this wave of speculative development and a distinct slowdown in demand and leasing activity due to a lack of funding for many mid-tier life science companies. In the first quarter 2004, the overall lab market availability rate was 22.2%.

Existing Lab Space	Total SF	Available SF (Vacant/ Sublease)	Availability Rate
Boston	1,868,904	169,170	9.1%
Cambridge	5,567,282	1,383,741	24.9%
Suburbs	5,586,930	1,513,060	20.1%
Worcester	950,278	841,500	4.4%
Total Leased Space	**13,973,394**	**3,107,471**	**22.2%**
Total Owner Occupied	6,242,496	32,200	0.5%
Total Combined	**20,215,890**	**3,139,671**	**15.5%**

Market Asking Rents	Asking Rent psf	TI Allowance psf
Boston		
New Space	$40 - $50 NNN	$80 - $135
2nd Generation/Sublease	$22 - $40 NNN	$0 - $50
Cambridge		
New Space	$40 - $48 NNN	$80 - $135
2nd Generation/Sublease	$22 - $40 NNN	$0 - $50
Suburbs		
New Space	$28 - $36 NNN	$75 - $125
2nd Generation/Sublease	$22 - $35 NNN	$0 - $50

Market Segments

Boston

Boston is home to internationally renowned academic, hospital, and health care organizations. The commercial lab market in Boston totals 1.9 million square feet, with very low availability, clustered in a few key areas including the Longwood Medical Area, Boston University's BioSquare, and the Charlestown Navy Yard.

Boston's **Longwood Medical and Academic Area** *(LMA)* is located three miles southwest of downtown Boston on a 210-acre site that represents a unique mix of institutional ownership, private real estate development, and private sector companies congregating on a shared campus. This mix is a prime example of how translational needs in the industry are increasing and fostering the exchange of information between clinicians and scientists and driving critical real estate decisions. The LMA's concentration of 21 institutions include four major Harvard-affiliated teaching hospitals *(Beth Israel Deaconess, Brigham and Women's, Children's Hospital, New England Baptist)*, two research treatment centers *(Dana-Farber Cancer Institute and Joslin Diabetes Center)* and three Harvard schools *(Medical, Public Health, and Dental)*.

Major research buildings were completed during the second half of 2003 for Harvard Institute of Medicine *(430,000 SF)* and Children's Hospital *(300,000 SF)* respectively. Additional projects underway include Merck's new 615,000 square foot research facility slated to open this fall, and an 18-story, 600,000 square foot speculative lab facility called Blackfan Research Center. The latter will add privately-developed commercial lab space in 2006. Overall, an additional 2.5 million square feet has been proposed for the near future in the LMA, including a recently approved plan for the 440,000 square foot, mixed-used Longwood North Research Center and proposed facilities for Beth Israel Deaconess and Joslin Diabetes Center.

Boston University's BioSquare is located along Boston's Albany Street corridor and encompasses 14 acres with a development potential of 1.2 million square feet of research, laboratory and office space. The BioSquare complex currently consists of 340,000 square feet of space that houses institutional research, private corporations and a research incubator. Construction will soon begin on the next building within BioSquare at 670 Albany Street *(below)*, a 160,000 square foot laboratory facility. In addition, Boston University Medical Center *(BUMC)* plans to establish a National Center for Emerging Infectious Diseases & Biodefense *(NCEIDB)* through an NIH grant.

Several life science tenants have research operations across the inner harbor from downtown Boston in **Charlestown**. Among them, Massachusetts General Hospital owns and occupies a 650,000 square foot research facility retrofitted in the late 1980s at 149 Constitution Drive.

CAMBRIDGE

Cambridge, wrapped around MIT and Harvard University, is the region's core lab market, with nearly 5.6 million square feet of investor-owned space and approximately 1.4 million square feet currently available for lease, including sublease space. Despite rising availability during the recent real estate downturn, the Cambridge lab market has posted consistent positive net absorption over the past several years including 2003 due to the numerous large build-to-suit projects for biotech and pharmaceutical companies including Alkermes, Biogen, Millennium Pharmaceuticals, Vertex Pharmaceuticals, Genzyme and, most recently, Novartis. Some of the gains from new tenants and large build-to-suit projects have been offset by the steady flow of sublease and second-generation space that emerged from several of the market's largest lab tenants as they have moved or consolidated. The excess space in the market has caused overall asking rents to decrease by 10-20% over the past two years.

The Cambridge lab market consists of a mix of new Class A facilities and older office or R&D buildings that have been revamped by tenants or building owners for life science use. The academic complexion of Cambridge has affected the lab market characteristics. Technology Square, owned by MIT, and University Park at MIT, each have in excess of 900,000 square feet of mostly occupied Class A lab space in East Cambridge in urban campus-style settings. In 2002, Novartis signed leases to occupy nearly 750,000 square feet of space in East Cambridge, including lab space under rehab at the former NECCO candy manufacturing facility, which will house the world research headquarters for Novartis when completed in 2004. Cambridge also has a significant presence of start-up, small and mid-sized biotechnology companies in leased space in East Cambridge, many of which started as spin-outs from MIT or local research institutions such as the Whitehead Institute. Additional proposed development in Cambridge includes North Point *(above)*, a 45-acre, 2.2 million square foot site on the East Cambridge/ Boston/Somerville line, that could be up to 70% life science use on a build-to-suit basis.

Outlook: Looking Ahead

The opportunity for Massachusetts to continue to lead the world's life science sector is extraordinary. Boston's Mayor, Thomas Menino, has recently hired a biotechnology "czar" to oversee and encourage the industry's growth. Boston University Medical Center overcame national competition and was awarded the right to build and run a Biosafety Level 4 (BSL-4) biocontainment laboratory. The BSL-4 lab is expected to generate $1.6 billion in research grants and will be one of the most significant research accomplishments in recent New England history.

Despite the excess lab space available and new construction underway in some submarkets in the region, several exciting development projects are planned targeting the life science sector for the future, driven by both private developers and institutional requirements.

Eli and Edythe Broad granted $100 million to fund a new type of biomedical research institution that combines the energies of Harvard, MIT and the Whitehead Institute in a concentrated effort to find cures for new diseases through study and application of the human genome. The Broad Institute recently committed to lease a 150,000 square foot laboratory facility to be developed at 7 Cambridge Center in Kendall Square.

Harvard University has announced a major expansion in the Allston/Brighton area of Boston, focused strongly on life science research. In February of 2004, Harvard announced that seven of its schools, seven teaching hospitals and close to 100 researchers and scientists would be collaborating to create the "Harvard Stem Cell Institute," an ambitious new institute with the simple goal of using stem cells to help the 150 million people nationally living with or dying from five types of organ and tissue failure. In its initial phase, the institute will be a "virtual" center, supporting research and drawing scientists together who work in laboratories that may be physically distant, but within a few years, Harvard hopes to add a central physical location for the institute, complete with laboratory facilities. Harvard has also recently announced the creation of a new Department of Systems Biology – the first new department established at Harvard in 20 years – which will combine natural science, computer science and biology in an attempt to understand complex biological systems.

Suburbs

Boston's Suburban lab market totals 6.5 million square feet clustered in several towns along central and northern Route 128 and 495 including Waltham, Lexington, Woburn, Framingham, and Worcester. Lab space in the suburbs is generally a mix of new build-to-suit projects and retrofitted office and R&D facilities, which provide a cost effective alternative to the Boston and Cambridge markets. The largest tenants with leased space in the suburbs include Boston Scientific in Quincy, Marlborough and Natick and Genzyme in Framingham. Suburban availability increased significantly between 2000 and 2003 due to a lack of leasing activity and inventory conversions targeting lab tenants, but increased activity and positive net absorption in early 2004 has brought availability down slightly to 23.8%. Watertown, Lexington, and Woburn each still have significant life science space availabilities in retrofitted buildings with asking rents in the $25-$35 psf NNN range. There are also several large life science companies that own their own facilities in the suburbs including AstraZeneca and Praecis Pharmaceuticals on Winter Street in Waltham, Wyeth and EISAI Research Institute in Andover, Millipore in Bedford and Billerica and Abbott Labs in Worcester.

The **Worcester** lab submarket is anchored by the University of Massachusetts *(UMass)* Medical Center and a new 700,000 square foot Worcester Medical Center. The health services industry is prominent within the city as there are more M.D.s and Ph.D.s per capita than in Boston. The majority of Worcester's commercially-available lab space is located in the Massachusetts Biotechnology Research Park, a development in close proximity to the UMass Medical Center. Worcester's 950,000 square foot lab market enjoys a very low availability rate under 5%, however the area's demand is significantly less than in Boston, Cambridge or the inner suburban market and is primarily driven by companies with a connection to the UMass Medical Center. The Abbott BioResearch Center *(ABC)*, the drug discovery and biologics manufacturing unit of Abbott Laboratories, is located in a 370,000 square foot owner-occupied building on a 30-acre site adjacent to the Massachusetts Biotechnology Research Park and UMass Medical Center. The ABC is expected to slowly expand in the Worcester area in the future.

RECENT TRANSACTIONS

TENANT	BUILDING ADDRESS	TOWN	SIZE (SF)
Broad Institute	7 Cambridge Center *(Proposed)*	Cambridge	150,000
Boston University	670 Albany Street *(under construction)*	Boston	96,000
Bayer Diagnostics	2 Edgewater Dr.	Norwood	98,157
Nitromed	125 Spring St.	Lexington	52,000

INCENTIVES

The Commonwealth of Massachusetts has supported a number of initiatives over the past 10 years to provide support for the growing life science industry. Below are some of the public and private organizations that provide support services, economic development, and incentives.

- The Massachusetts Technology Collaborative
- The Massachusetts Biomedical Initiative *(MBI)*
- Bioventure Investors LLC
- The Massachusetts Development Finance Agency *(MassDevelopment)*
- The Massachusetts Biotechnology Council

Sources: "State Government and Biotechnology 2001," Battelle Memorial Institute, www.bio.org/tax/battelle.pdf

NOVARTIS • CAMBRIDGE, MA

BASEL, SWITZERLAND-BASED NOVARTIS WANTS TO REVOLUTIONIZE THE MANNER IN WHICH DRUGS ARE DISCOVERED. IN AN ATTEMPT TO MOVE AWAY FROM THE TRADITIONAL PHARMACEUTICAL RESEARCH AND DEVELOPMENT METHODS, NOVARTIS CEO DANIEL VASELLA MADE THE BOLD DECISION TO RELOCATE THE FIRM'S RESEARCH HEADQUARTERS TO A BIOTECH HUB RATHER THAN A TRADITIONAL PHARMACEUTICAL CENTER SUCH AS BASEL OR NEW JERSEY. ALTHOUGH BIOTECH HOTBEDS SUCH AS SAN FRANCISCO AND SAN DIEGO TOPPED THE EARLY LIST, VASELLA CHOSE CAMBRIDGE BECAUSE HARVARD PHYSICIAN AND SCIENTIST DR. MARK FISHMAN AGREED TO BE NOVARTIS' HEAD OF RESEARCH. THE INTELLECTUAL INFRASTRUCTURE AND THE SIZE OF THE LOCAL BIOTECHNOLOGY INDUSTRY ALSO CONTRIBUTED TO NOVARTIS' STRATEGIC RELOCATION TO THE BOSTON AREA. NOVARTIS HAS 750,000 SQUARE FEET OF SPACE IN CAMBRIDGE OCCUPIED OR IN THE DESIGN PHASE. OVER THE NEXT 10 YEARS THE COMPANY PLANS TO INVEST $4 BILLION IN FACILITIES AND EXPAND TO MORE THAN 1,000 EMPLOYEES.

Source: Inventing Designer Drugs by Moving to Cambridge, Novartis bets $4.0 billion it can revamp the science of the Pharmaceutical Industry." Naomi Aoki, The Boston Globe April 13, 2003.

NEW YORK/NEW JERSEY/CONNECTICUT

DID YOU KNOW?

60% OF THE NATION'S PHARMACEUTICAL INDUSTRY IS LOCATED IN THE IMMEDIATE VICINITY OF NEW YORK CITY, INCLUDING 19 OF THE WORLD'S LARGEST PHARMACEUTICAL AND MEDICAL TECHNOLOGY COMPANIES.

Source: New York Bioscience Initiative, www.nybioscience.com

MARKET OVERVIEW

The New York/New Jersey/Connecticut life science cluster represents the nucleus of large pharmaceutical companies in the U.S. The primary attractions to the area are its location in the center of the northeast corridor *(from Boston to Washington, DC)*, the access to tremendous sources of investment capital and the significant concentration of academic institutions. Geographically, this cluster is one of the largest in the nation, covering several distinct submarkets and a significant diversity of facilities from New York City, south to northern and central New Jersey and north into Connecticut.

New York City and Northern New Jersey are traditionally home to corporate locations of large pharmaceutical companies. With a physical lack of space and a high cost of business in Manhattan, this cluster has spread over the past two decades, with major pharmaceutical companies expanding into campus-style facilities in New Jersey, outside New York City in Westchester County and Long Island and throughout southern Connecticut from New Haven to New London. Additionally, the area's renowned academic institutions, including Princeton University, Columbia University, New York University and Yale University, along with major clinical care hospitals and abundant public and private capital have fostered a growing research and biotechnology sector. The region's core life science submarkets on the whole, particularly for new, leasable lab space, have historically been supply-constrained, however several new life science development projects have been delivered or are planned throughout the corridor, ranging from biotechnology incubators to large-scale institutional and commercial facilities.

INDUSTRY DRIVERS

The nation's largest assembly of financial resources and investment capabilities are clustered in this region. In 2002, Sloan Kettering Institute for Cancer Research and Cold Spring Harbor Laboratory, both located in New York, ranked 4th and 13th respectively, out of NIH support to research institutes across the country, receiving a combined $114 million in funding. In 2003, Yale University and Columbia University ranked 11th and 14th , respectively, in NIH funding, receiving a combined $594 million in grants. In addition, local companies and scientists were awarded the most life science-related patents in the country during the 1990s - 70% more than the San Francisco area.

INDUSTRY DRIVERS*

INDUSTRY DRIVERS	TOTAL	RANK**
Life Scientists 1998	>4,700	3
NIH Funding 2002 *(in millions)*	$1,709	2
Venture Capital Funding for Biotech Companies 2003 *(in millions)*	$502	3
Biotechnology Patents *(1990-1999)*	6,800	1
Number of Biotechnology Companies 2002	137	3

MAJOR PLAYERS

The large pharmaceutical companies dominate the New York/New Jersey/Connecticut life science cluster. Johnson & Johnson's incorporation in 1886 marks the beginning of the life science presence in a region that currently hosts 15 of the 20 largest pharmaceutical companies in the world. The region also benefits from the dense concentration of academic and research capital, which provides the ideal environment for basic research and technology transfer. Highly-acclaimed educational resources, including Columbia, Princeton and Yale Universities, in combination with a handful of independent research institutions play a major role the area's life science industry. Yale University, located in New Haven, Connecticut, is a leader in medical research and has established more than a dozen biotech startups in the past decade. Additionally, Columbia and Rockefeller Universities have contributed to regional innovation since the 1980s.

Major Players

MAJOR INSTITUTIONS

Academic Research/ Medical	Clinical Teaching Hospitals	Independent Research Institutions
Columbia University	Beth Israel Health Care Center	Brookhaven National Laboratory
Cornell University *(Weill Medical College)*	Columbia Presbyterian Medical Center	Cold Spring Harbor Laboratory
New York University *(Sackler Institute of Graduate Biomedical Sciences)*	Lenox Hill Hospital	Sloan - Kettering Institute for Cancer Research
Princeton University	Memorial Sloan-Kettering Cancer Center	
Rockefeller University	New York Presbyterian Hospital	
Rutgers University	NYU Medical Center	
SUNY Stony Brook University of Connecticut	Saint Vincent's Hospital and Medical Center	
Yale University	St. Luke's Roosevelt Hospital	

MAJOR SECTOR PLAYERS

Pharmaceutical Companies	Biotechnology Companies	Medical Device Companies
Aventis Pharmaceuticals *Bridgewater, NJ*	**Berlex Laboratories, Inc.** *Wayne and Montville, NJ*	**Cambrex Corporation** *East Rutherford, NJ*
Bayer HealthCare *Morristown, NJ*	**Celgene Corporation** *Warren, NJ*	**Janssen Pharmaceutical Products, LP** *Titusville, NJ*
Bayer Pharmaceuticals Corporation *West Haven, CT*	**Enzon Pharmaceuticals, Inc.** *Bridgewater, NJ*	**Pall Corporation** *East Hills, NY*
Boehringer-Ingelheim Pharmaceuticals *Ridgefield, CT*	**Eyetech Pharmaceuticals, Inc.** *New York, NY*	
Bristol-Myers-Squibb Co. *New York, NY, Wallingford, CT, Lawrenceville, NJ*	**ImClone Systems, Inc.** *New York, NY, Branchburg, NJ*	
Forest Laboratories, Inc. *New York, NY*	**Lexicon Genetics, Inc.** *Princeton, NJ*	
Hoffmann-La Roche, Inc. *Nutley, NJ*	**Medarex, Inc.** *Princeton, NJ*	
Johnson & Johnson *New Brunswick, NJ*	**OSI Pharmaceuticals, Inc.** *Melville, NY*	
Merck & Co. *Whitehouse Station, NJ*	**Progenics Pharmaceuticals, Inc.** *Tarrytown, NY*	
Novartis Pharmaceuticals *East Hanover, NJ*	**Regeneron Pharmaceuticals, Inc.** *Tarrytown, NY*	
Pfizer, Inc. *New York, NY, Groton, CT*		
Purdue Pharma LP *Stamford, CT*		
Schering-Plough *Kenilworth, NJ*		
Wyeth *Madison, NJ*		

Lab Market Snapshot

New York Regional Lab Market

Existing Lab Space			
	Total SF	Available SF (Vacant/ Sublease)	Availability Rate
Manhattan	500,000		
Long Island	1,000,000		
Westchester County	1,000,000		
Total Leased Space	**2,500,000**	**250,000**	**10%**

The New York lab submarket includes Manhattan, Long Island and Westchester County and totals approximately 2.5 million square feet of developed, investor-owned wet lab space, though there is nearly 16 million square feet of flex or R&D space that may be capable of lab use in the future. The majority of existing and proposed lab space in the greater New York City lab market is clustered into life science developments or parks. The current vacancy rate of approximately 10% has seen a slight decrease over the past two years from its high in mid-2002. Despite the concentration of pharmaceutical companies and academic institutions in and around New York City, the area sorely lacks wet lab facilities near major universities. The demand has led to a number of new and proposed commercial biotechnology-specific real estate developments in New York City and around the region.

Manhattan

Officials in Manhattan and the surrounding region have specifically targeted the life science industry as they continue to look for ways to turn the economy around after September 11th. The state's primary goal is to identify startup life science companies that want to locate or expand in the New York area and help them secure funding and available space that suit their needs, with the objective of creating clusters of biotech startups in nodes in and around the city. Pfizer, the pharmaceuticals giant that is growing by leaps and bounds in Manhattan, is expected to stimulate the industry in the city. In mid-2003, Pfizer announced that it intends to grow its presence in the area, and that it will add 1,000 jobs in Manhattan in the immediate future with another 2,300 in the long-term by relocating its employees from New Jersey, Michigan and California. For some time now, Pfizer has been expanding its corporate campus along 42nd Street in midtown Manhattan and it expects to invest about $1 billion in New York City over the next 15 years.

Audubon Biomedical Science and Technology Park is an existing project by Columbia University Medical Center and New York Presbyterian Hospital that currently has approximately 100,000 square feet completely occupied and will eventually encompass one million square feet in four Class A buildings. It is located in Manhattan on Broadway between 165th and 168th Streets and is in the Upper Manhattan Empowerment Zone, rendering the development eligible for a number of incentive packages from the City and State. Audubon is the only university-related research park of its kind in New York City, and it currently houses over 20 biotechnology companies.

State University of New York *(SUNY)* Downstate in Flatbush, Brooklyn is developing an **Advanced Biotechnology Park** with an incubator facility, the first phase of which includes 11,000 square feet *(opened in February 2004)* and will increase to 50,000 square feet in additional planned phases. Eventually it is hoped that the Park will contain over 500,000 square feet, but there are currently only 400 to 3,000 square feet of wet/dry lab and office space available. The anchor tenant is ImClone Systems, which is locating its new Division of Small Molecule Compounds in the Park. The objective of the park is to help convert Brooklyn's redundant manufacturing space for biotech use, and to create job-training programs for scientists and technicians.

Hutchinson Metro Center, near Fordham University in the Bronx, features a 460,000 square foot building, completely renovated in 2002, which contains both office and lab research space.

Long Island

Broad Hollow Bioscience Park, at Farmingdale State University on Long Island, is a nonprofit 65,000 square foot facility that includes an incubator wing along with the research headquarters of OSI Pharmaceuticals. Two startups are also located here, Helicon Therapeutics and Immuno-Rx. A second building of 50,000 square feet is planned for startup biotech companies in the near future. **Long Island High Tech Incubator** is a cluster of buildings totaling approximately 110,000 square feet of existing occupied space in a campus development at SUNY Stony Brook. Additionally, the **North Shore Long Island Jewish Medical Center** has developed a research institute charged with understanding the underlying biological processes of disease and developing new and more effective therapies for patients. The five "core facilities" in the development are molecular genetics, flow cytometry, molecular biology, an imaging laboratory and mass spectrometry.

Westchester County

Weschester County has also been targeted as a key area for life science growth. The **Landmark at Eastview** is a multi-tenant 270-acre master planned science park that includes five major buildings and a total of 740,000 square feet on the campus in a mix of office and lab facilities. Approximately 33,000 square feet of space is currently available for wet lab use. Biotech tenants include Aton Pharma, Emisphere Technologies, Progenics Pharmaceuticals and Regeneron Pharmaceuticals.

NY Market Outlook

Lower Manhattan Bioscience Center. To offset a high vacancy rate in Lower Manhattan, there is an outstanding proposal for a number of startup biotech firms to cluster in buildings downtown. To that end, a $5 million grant has been made by the New York State Assembly that will help convert 300,000 square feet of empty commercial space into R&D space.

East River Science Park is a proposed three building, seven-acre project totaling 700,000 to 1,000,000 square feet to be developed in close proximity to the New York University Medical Center, Bellevue Hospital Center and the Veterans Administration Medical Center in Midtown Manhattan.

The largest potential life science development project on the horizon for Westchester County is by **New York-Presbyterian Hospital** *(NYPH)*. The first phase includes a 386,000 square foot building on twelve acres, including a 991-car structured parking garage. One-third of the building will be speculative space with the NYPH affiliates, Cornell and Columbia Universities, occupying the remaining portion. The development will include support facilities specific to life sciences and will also include clinical and R&D space. This project has been designated as a "Center of Excellence in Biotechnology" by Governor Pataki.

New York Presbyterian Hospital
Westchester County, New York

New Jersey Regional Lab Market

Existing Lab Space			
	Total SF	Available SF (Vacant/ Sublease)	Availability Rate
Total Leased Space	3,525,000	710,000	20.1%
Total Owner Occupied	10,000,000		

The New Jersey life science submarket is dominated by nearly 10 million square feet of space owned, occupied and operated by "Big Pharma," including Merck, Pfizer, Johnson & Johnson, Aventis and Bristol-Myers-Squibb. Much of this space is highly-specialized, older generation space located in mature markets. The bulk of the 3.5 million square foot investor-owned New Jersey lab submarket is found in Middlesex and Mercer County. Currently, availability is just over 20% in those areas, with notable availabilities in buildings built in Cranbury, Princeton and New Brunswick.

Market Asking Rents		
	Asking Rent psf	TI Allowance psf
New Jersey	$20 - $45 NNN	up to $150

Recent transactions in Central New Jersey's Route 1 corridor between Rutgers University in New Brunswick and Princeton have pushed the market to the tipping point. Kos Pharmaceuticals and Amicus Therapeutics have combined to take 75,000 square feet in Cranbury at Cedar Brook, while Rutgers has taken 30,000 square feet in Tech III of the Technology Centre of New Jersey in New Brunswick. Rutgers will expand and relocate its successful incubator program to the Technology Centre, with the intent of providing shared services that are complementary to those offered by the Commercialization Center for Innovative Technologies, which was developed by the Economic Development Authority *(NJ-EDA)* at the same location.

Rentals at these projects are calculated at $11 per square foot for a standard shell, with improvements funded by the developer at interest rates below market level. Generally, up to $150 per square foot in improvements translates to gross rentals in the $38 to $45 per square foot range. The asking rental rates for new transactions have remained steady throughout the last three years, as net absorption has held at a pace close to 225,000 square feet per year since the end of 2000. There are currently outstanding requirements in this area in the amount of 500,000 square feet.

New Jersey Market Outlook

A total of 510,000 square feet of research space will come on-line by early 2005 at the Technology Centre and at Cedar Brook in Cranbury. The former offers flexible lab suites ranging from 6,000 square feet up to 60,000 square feet with tenants including Access Bio, Merial Limited, Cambrex Corporation and Semorex. Cedar Brook totals 250,000 square feet that is currently in the design phase and will break ground by the end of the summer.

Connecticut Regional Lab Market

The Connecticut life science submarket has stemmed from the prominent location of some major pharmaceutical companies and academic research in the area. Three of the top ten and five of the top twenty pharmaceutical companies in the world maintain R&D operations in Connecticut, including Pfizer in New London, Bristol-Myers Squibb in Wallingford, Aventis in Avon, Boehringer-Ingelheim in Ridgefield and Bayer in New Haven. Some of these large companies are continuing to actively expand in the state. In 2000, Pfizer opened a 585,000 square foot state-of-the-art global R&D headquarters facility in New London. Pfizer's R&D division is the world's largest private biomedical R&D operation. In total, Pfizer's campus includes over 3.0 million square feet housing nearly 7,000 employees in New London and Groton, CT.

Academic research led by Yale University and the University of Connecticut also plays an integral role in the Connecticut life science landscape and growth potential. Yale, located in New Haven, is an academic institution that has committed to conducting and teaching biological and biomedical research, and is a founding member of Connecticut United for Research Excellence *(CURE)*, the state's life science industry group. The main commercial lab property in New Haven is the Technology Center at 300 George Street, an existing 520,000 square foot, Class B building adjacent to Yale Medical School. Life science tenants of the Technology Center include Achillion Pharmaceuticals, Rib-X Pharmaceuticals and Molecular Staging. Additionally, Science Park at Yale is an 80-acre, master planned mixed-use redevelopment project located adjacent to Yale with 1.0 million square feet of potential lab conversion space. The first phase of the project is the redevelopment of a 260,000 square foot industrial building.

Incentives

New York, New Jersey, and Connecticut each have a wide array of initiatives underway to encourage the growth and development of the state's life science industry. Below are some of the public and private organizations that provide support services, economic development, and incentives.

New York

- The New York Venture Capital Investment Program.
- The Biotechnology Industry Growth Fund
- The Small Business Technology Investment Fund
- The NYS Common Retirement System
- The New York Biotechnology Association

New Jersey

- The High Tech Job Retention Act
- The R&D Excellence Awards Program
- The Transfer and Commercialization Program
- Advanced Biotechnology and Medicine
- Early State Enterprises
- The Biotechnology Council
- Health Care Institute
- New Jersey Economic Development Authority

Connecticut

- Connecticut United for Research Excellence
- The Biotechnology Facilities
- Connecticut Innovations
- Connecticut Innovations' Yankee Ingenuity Technology Competition
- The Connecticut Biotechnology Facilities Fund

Sources: New York Bioscience Initiative, Partnership for New York City, Crain's New York Business; New York City Economic Development Corporation, CoStar; New Jersey Biotechnology & Life Sciences Coalition, www.NJBLSC.org; Biotechnology Council of New Jersey, Inc., www.NJBIOTECH.org; New Jersey Economic Development Authority, www.NJEDA.com; "State Government and Biotechnology 2001," Battelle Memorial Institute, www.bio.org/tax/battelle.pdf

PHILADELPHIA

DID YOU KNOW?

PENNSYLVANIA IS HOME TO THE FIRST HOSPITAL IN THE UNITED STATES, THE PENNSYLVANIA HOSPITAL, WHICH WAS COFOUNDED BY BENJAMIN FRANKLIN IN 1751.

MARKET OVERVIEW

Greater Philadelphia's life science cluster has been home to pharmaceutical companies for decades, benefiting from its central location on the East Coast and proximity to public and private funding sources. It has been estimated that more than 75% of the world's largest pharmaceutical companies have located administrative offices, R&D and manufacturing facilities in the area. The majority of the life science real estate supply in Philadelphia is owner-occupied and not commercially-available. Landlords are increasingly considering redevelopment of existing R&D and manufacturing facilities to lab space, however a prospective tenant's credit, science and business plan may be heavily scrutinized before embarking on such build-out. Geographically, the area stretches from just west of Philadelphia, Pennsylvania and includes central New Jersey and Northern Delaware.

INDUSTRY DRIVERS

Greater Philadelphia maintains the second largest concentration of medical schools and clinical teaching hospitals in the country. The Philadelphia area boasts the highest percentage of physicians engaged in academic research of all U.S. metropolitan areas. The Hospital of the University of Pennsylvania ranked in the top ten for four specialty areas in the 2003 ranking of hospitals by U.S. News and World Reports. In 2002, the University of Pennsylvania ranked third nationally in National Institutes of Heath *(NIH)* awards to universities, receiving over $434 million in grants, and two Philadelphia area independent research institutes, the Fox Chase Cancer Center and the Wistar Institute, ranked in the top fifteen in the country receiving $30 million and $24 million, respectively.

MAJOR PLAYERS

Stemming from the region's hospitals and research institutions, the Philadelphia area maintains an impressive array of collaborative research enterprises engaging in cross-discipline, multi-institutional and private partnerships. Animal health research and agricultural biotech are emerging regional industries.

Philadelphia has the second highest concentration of life science jobs in North America, with an estimated 120 hospitals, 200 biotechnology and pharmaceutical firms, and 135 medical manufacturers. In addition to large pharmaceutical companies, generic drugmakers such as URL/Mutual Pharmaceutical Company, Teva Pharmaceuticals and Global Pharmaceutical Corporation have also expanded in the region amidst a surge in demand for generic drugs. The Philadelphia life science market has benefited greatly from the collaboration between the institutions, large pharmaceutical companies, and start-up life science companies. This environment has helped shape the region's 17 publicly-traded life science companies and start-ups. A study conducted by the U.S. Department of Commerce confirms that the number of established life science companies in Pennsylvania is growing and increased 27% from 1997-2001, a growth rate eclipsed by only four states.

INDUSTRY DRIVERS*

INDUSTRY DRIVERS	TOTAL	RANK**
Life Scientists 1998	>4,410	7
NIH Funding 2002 *(in millions)*	$811	6
Venture Capital Funding for Biotech Companies 2003 *(in millions)*	$207	5
Biotechnology Patents *(1990-1999)*	3,007	3
Number of Biotechnology Companies 2002	61	8

Sources: Pennsylvania Department of Community and Economic Development, www.inventpa.com

Major Players

Major Institutions

Academic Research/ Medical	Clinical Teaching Hospitals	Independent Research Institutions
Pennsylvania State University	Albert Einstein Medical Center	Center for Advance Biomedical Research
Thomas Jefferson University	Children's Hospital of Philadelphia	Center for Bioinformatics
University of Pennsylvania	Fox Chase Cancer Center	Center for Recombinant Protein Production and Structure Evaluation
	Hospital of the University of Pennsylvania	Lankenau Institute for Medical Research
	Magee Rehabilitation Hospital	Monell Chemical Senses Center
	Pennsylvania Hospital	Nanotechnology Institute
	St. Christopher's Hospital Temple University Hospital	National Disease Research Interchange
	Thomas Jefferson University Hospital	Wistar Institute
	Wills Eye Hospital	

Major Sector Players

Pharmaceutical Companies	Biotechnology Companies
AstraZeneca International *Wayne*	**3 Dimensional Pharmaceuticals** *Yardley*
Aventis Behring *King of Prussia*	**Cephalon, Inc.** *Westchester*
GlaxoSmithKline, Inc. *Philadelphia*	**Elan Pharmaceuticals** *King of Prussia*
Ortho-McNeil Pharmaceutical, Inc. *Raritan*	**Genaera Corporation** *Plymouth*
Teva Pharmaceuticals USA *North Wales*	**MeetingCell Pathways, Inc.** *Horsham*
Wyeth *Collegeville*	**Neose Technologies, Inc.** *Horsham*
	Shire Pharmaceuticals Group *Philadelphia*
	ViroPharma, Inc. *Exton*

Lab Market Snapshot

Existing Lab Space			
	Total SF	Available SF (Vacant/ Sublease)	Availability Rate
Total Leased Space	6,400,000	1,760,000	27.5%

It is difficult to obtain a true estimate of the lab market in Greater Philadelphia. The large pharmaceutical complexes include integrated office, production, and lab space. There has been very little space developed primarily as lab space and as a result, much of the occupied lab space is flex or former high-tech space that has undergone substantial renovation on an as-needed basis. The investor-owned lab "capable" market consists of approximately 6.4 million square feet with a vacancy rate of 27.5%. The major pharmaceutical companies own their own facilities and there has been a trend toward consolidating from leased satellite locations to owned campuses.

The suburban lab market is clustered along the Route 202 corridor from Malvern to West Chester, Fort Washington/Gwynedd, and Collegeville/Oaks. In addition, AstraZenaca recently opened its new U.S. Headquarters in suburban Wilmington, Delaware. The largest suburban lab tenants include Merck, GlaxoSmithKline, Ortho-McNeil, Cephalon, 3-D Pharmaceuticals, ViroPharma, West Company and Rohm & Haas.

Small firms take advantage of the local incubator opportunities such as the Port of Technology, located near Drexel University and the University of Pennsylvania in Philadelphia's Tech Corridor, the University Science Center near the University of Pennsylvania, and the Delaware Technology Park in Newark, Delaware. These facilities allow entrepreneurs to rapidly develop their businesses in a state-of-the-art, plug-and-play environment. The Port of Technology also offers on-site mentoring, wet lab facilities, and ready access to venture capital and an influential network of business leaders.

Market Asking Rents	
	Asking Rent psf
Overall Market	$20 - $24 NNN

There is a wide variation in asking rents for lab space because of the diversity of building types that have lab opportunities. On average, asking rents for lab space range from $22 to $24 per square foot NNN.

Incentives

Over the past few years Pennsylvania has launched several initiatives, which will promote the growth of the life science industry and accelerate the commercialization of research conducted at the State's universities. Below are some of the public and private organizations that provide support services, economic development, and incentives.

- The Pennsylvania Early Stage Partners
- Pennsylvania's Capital Budget
- The Pennsylvania Biotechnology Association

Source: State Government and Biotechnology 2001" Battelle Memorial Institute, www.bio.org/tax/battelle.pdf

DEVOTION TO CANCER CARE

Lankenau Institute / Wynnewood, PA

Monell Chemical Senses Center / Philadelphia, PA

PROCUREMENT & DISTRIBUTION OF HUMAN TISSUES AND ORGANS

Philadelphia Institutions

Fox Chase Cancer Center's 100-bed hospital is the fourth largest in the country devoted entirely to cancer care. The research is primarily focused on gene expression; molecular aspects of oncogenesis; viral molecular biology and pathogenesis; molecular structure and function analysis; pharmacology and therapeutics; regulation and development of the immune system; cell cycle control; and human genetics.

Lankenau Institute for Medical Research conducts research and research training in the biological mechanisms of aging and the diseases associated with it, including cancer, cardiovascular disease, osteoporosis and age-related neurodegenerative disorders.

Monell Chemical Senses Center was the world's first scientific institute for multidisciplinary research on taste, smell and chemosensory irritation. Monell and the University of Pennsylvania maintain a close relationship. Approximately half of Monell's funding comes from government agencies, with the remainder coming from foundations, corporate sponsorships, gifts and grants.

The National Disease Research Interchange (NDRI) is a unique non-profit organization engaged in the procurement and distribution of human tissues and organs for biomedical researchers primarily in the U.S. NDRI receives funding currently from the National Center for Research Resources of the National Institutes of Health, the Juvenile Diabetes Foundation International and corporate and privates sources.

What's Hot

Shire Pharmaceuticals Group, Britain's third-largest drug company, has chosen suburban Philadelphia for its U.S. headquarters. The company will consolidate, closing its sites in Newport, Kentucky and Rockville, Maryland. Shire is refocusing its R&D efforts and technology to concentrate on late-stage projects.

University Bioscience & Technology Group will develop a $65 million life science research facility near the University of Pennsylvania. The facility will house a translational research program initiated by scientists at the University's medical school and funded by a group of investors and the NIH.

WASHINGTON D.C. / BALTIMORE

DID YOU KNOW

IN 2004, THE NIH, WHICH BEGAN IN 1887 AS A ONE-ROOM LABORATORY, HAS IN EXCESS OF 75 BUILDINGS LOCATED ON MORE THAN 300 ACRES.

Source: National Institutes of Health www.nih.gov

MARKET OVERVIEW

The Washington, DC and Baltimore, Maryland corridor is home to two of the primary institutional research forces in the life science industry. The National Institutes of Health *(NIH)*, located in Bethesda, Maryland, is the nation's primary federal organization for funding medical research and scientific discovery. Johns Hopkins University *(JHU)* in Baltimore is the largest federally-supported academic research institution in the country and boasts one of the leading medical centers in the world. This established federal and academic infrastructure has created a life science "power alley" and the region has grown to be one of the core locations for the growing life science industry. This market has also been a leader in the mapping of the human genome, and is home to not only the publicly-funded Human Genome Project, but also the Biotechnology Industry Organization *(BIO)*, the life science industry's leading trade organization. The region has primarily attracted biotechnology companies and industry service and equipment suppliers.

The regional lab market is segmented into two submarkets, one around the Metro DC - along I-270 in Montgomery County Maryland and in isolated spots within Northern Virginia - and the other is clustered in and around Baltimore.

INDUSTRY DRIVERS

NIH is the world's single largest source of funding for medical research. In the past five years, NIH's budget has increased to $27.1 billion, an average increase of around 15% annually, but is expected to plateau in the coming years. As a result of these funds appropriated for NIH, the Washington-Baltimore region has historically been among the highest in federal support, ranking third after Boston and New York in total funding in 2002. In total amount of research funding from NIH in 2003, Johns Hopkins University *(JHU)* garnered almost $556 million alone, making it the leading recipient of NIH research funding. JHU's School of Medicine is the also largest recipient of NIH research grants to medical schools. While federal funding has been abundant, the region as a whole, and particularly Washington, DC has historically lagged other core biotech clusters in venture capital funding.

MAJOR PLAYERS

NIH plays a significant role in the regulation of the development of new diagnoses and therapies, and its Bethedsa, Maryland campus anchors the industry's **Federal sector**. The 70 building, 322-acre NIH campus encompasses the largest biomedical research facility in the world. Approximately 17,000 people work in more than 8.0 million square feet of laboratories, research hospital rooms, teaching facilities and offices. The Food and Drug Administration *(FDA)* and the National Institute for Standards and Technology *(NIST)* are also headquartered in suburban Maryland, allowing for the drug approval and patent processes to be potentially smoother for area companies. Baltimore is home to NIH's intramural research programs for the National Institute on Aging and National Institute on Drug Abuse. The U.S. Defense Advanced Research Projects Agency *(DARPA)* is based in Arlington, Virginia, performing biological, infotech and microtech research and Fort Detrick in Frederick, Maryland is home to the US Army Medical Research Institute of Infectious Diseases and the National Cancer Institute.

INDUSTRY DRIVERS*

INDUSTRY DRIVERS	TOTAL	RANK**
Life Scientists 1998	>6,600	1
NIH Funding 2002 *(in millions)*	$1,238	3
Venture Capital Funding for Biotech Companies 2003 *(in millions)*	$91	7
Biotechnology Patents *(1990-1999)*	2,162	T4
Number of Biotechnology Companies 2002	116	4

Major Players

MAJOR INSTITUTIONS

Academic Research/ Medical	Clinical Teaching Hospitals	Independent Research Institutions
Georgetown University	Georgetown University Medical Center	Carnegie Institution of Washington
George Washington University	George Washington University Medical Center	Howard Hughes Medical Institute
Johns Hopkins University	Johns Hopkins Bayview Medical Center	Institute for Genomic Research
University of Maryland		Kennedy Kreiger Institute
University of Maryland at Baltimore		National Biomedical Research Foundation
		National Cancer Institute
		National Institutes of Health
		UMD Biotechnology Institute
		U.S. Army Medical Research Institute of Infectious Diseases

MAJOR SECTOR PLAYERS

Pharmaceutical Companies	Biotechnology Companies
Eli Lilly & Co.	BioReliance Corporation *Rockville*
Novartis Pharmaceuticals Corporation	Celera Genomics Group *Rockville*
Otsuka America Pharmaceutical, Inc. *Montgomery County*	EntreMed, Inc. *Rockville*
Shire Laboratories, Inc. *Rockville*	Gene Logic, Inc. *Gaithersburg*
	Guilford Pharmaceuticals, Inc. *Baltimore*
	Human Genome Sciences *Rockville*
	MedImmune, Inc. *Gaithersburg*

The region's **academic sector** revolves around JHU. There are other academic institutions in the area, including the University of Maryland *(UMD)*, University of Maryland at Baltimore *(UMB)*, Georgetown University and George Washington University, but they receive low levels of federal funding relative to JHU. UMD runs its own incubator-style program - Maryland Industrial Partnerships *(MIPS)*. MIPS is a cooperative business development program for engineering, physical science, life science and computer science. The program sets up startup research organizations on the UMD campus and funds up to $100,000 per year in research costs. In the Washington-Baltimore area, there are also a few key independent research institutions, such as the Howard Hughes Medical Institution *(HHMI)* in Chevy Chase, a nonprofit medical research organization with a 2002 endowment of nearly $11 billion, which employs hundreds of leading biomedical scientists. Through its far-reaching grants and other activities, HHMI is helping to enhance science education at all levels and maintain the vigor of biomedical science worldwide.

Biotechnology, life science, biodefense and pharmaceutical firms have found it beneficial to locate close to NIH in order to capitalize on the broad knowledge base and to foster strategic interaction and cooperation. From the private sector, biotech firms focusing on research have the largest presence in the area. Although there are several large biotech companies in the area, the bulk of the companies have less than 50 employees and concentrate on R&D operations. The region's pharmaceutical industry presence is represented by R&D alliances between large pharmaceutical companies and small biotech firms. These alliances exist in the form of research collaboration, funding and acquisition.

With the rise of the region's biotechnology industry has come an influx of suppliers for the industry. As it is a rapidly-growing and developing science, biotechnology requires cutting edge tools and chemicals to perform groundbreaking research. The supply firms are primarily involved in the development of reagents, diagnostics and cell culture products for use in genetic research. The largest supply firm in Virginia is Fisher Diagnostics, while Maryland is home to Cambrex Bio Science, Digene, and Qiagen. The location of these firms in the Metro DC area allows for easy collaboration and cooperation with NIH, JHU and the local biotechnology firms in the research and development of analytical supplies and diagnostic materials.

Lab Market Snapshot

Metro DC Lab Market

Geographically, life science firms in the metropolitan area around Washington, DC are clustered around the NIH headquarters in Bethesda, along the I-270 Corridor in Montgomery County, on East Gude Drive in Rockville and at the Shady Grove Life Sciences Center in Gaithersburg. Additionally, some facilities can be found scattered throughout the county as far east as Silver Spring and as far north as Germantown. Incubator facilities are located in Fairfax County, Virginia and Montgomery County, Maryland. Excluding the Shady Grove Life Sciences Center, life science companies generally coexist with firms from other industries. There are currently 5.6 million square feet of flex buildings in the I-270 Corridor with 1.2 million square feet of vacant space, representing a 22.4% availability rate. Overall, however, built-out wet lab space is still very difficult to find in the market.

On the demand side, after developing quickly in the late 1990s into 2001, the life science market slowed in 2002 and 2003, due to nationwide economic uncertainty, anticipated cutbacks in NIH funding and several mergers and consolidations in the pharmaceutical and biotechnology industries. Many built-out lab spaces were placed on the market for sublease due to funding issues and product failure. In terms of space planning, most life science firms have taken a "wait and see" approach, dependent upon future NIH funding, which will drive contract growth and space demand. Recently demand has increased for flex buildings able to accommodate laboratory build-outs.

Shady Grove is the epicenter of Montgomery County's life science industry with the Shady Grove Life Sciences Center, and JHU and UMD campuses located there. The UMD campus is home to the Center for Advanced Research in Biotechnology *(CARB)*. Other significant players in this submarket are Human Genome Sciences, the Institute for Genomic Research and Celera Genomics, all of which are involved in human genome research. The Maryland Technology Development Center, a 50,000 square foot facility located on the 1.5 million square foot campus of the Shady Grove Life Sciences Center, will soon open a second location at the Silver Spring Innovation Center. Recently, JHU has undertaken a project to expand their campus to act as an incubator for small bioscience firms. Scheduled for completion in the fall of 2004, Building 3 will add 50,000 square feet of classrooms and lab space as well as commercially-available space for science and technology-related tenants.

The **Twinbrook** area has been called the "First Life Sciences Center," with about 500,000 square feet of FDA and NIH leased lab space in the area. The Parklawn Building, which is the largest office building in the county, currently houses U.S. Health and Human Services Offices including the FDA. The FDA has commenced its move and consolidation of operations to its new White Oak Campus in Prince George's County, Maryland. When completed, the facility will include 14 interconnected buildings totaling 2.3 million square feet, forming a campus-like setting that will replace existing facilities spread throughout Montgomery County.

HHMI broke ground on its 760,000 square foot complex in **Loudon County,** Virginia in May of 2003. This facility, which is located in the Janelia Farm Research Campus, will house 200 to 300 scientists who will carry out biomedical research. Hospital Corporation of America has also purchased 55-acres of land at Broadlands and plans to develop a 164-bed hospital on the site. Currently this project awaits approval from the Board of Supervisors.

Metro DC Outlook

There are currently 22 life science companies looking for space in Montgomery County totaling 657,200 square feet of potential demand, however these requirements are contract-based and do not represent the true level of demand in the Metro DC area. With a large amount of single-story flex and several build-to-suit opportunities, the Metro DC market is able to give life science entities the options needed for office, lab or production facilities. The proximity to NIH and its wealth of funding and knowledge gives firms great incentive for locating in the region, and although NIH's future budget expansion is expected to wane, it is widely acknowledged that the biotech - particularly biodefense - industries will continue to grow. With the combination of small research firms and large national firms located in the area, the Metro DC area has positioned itself well to continue to be a hotbed of growth for the life science industry.

National Institutes of Health, Building 33 Complex
Bethesda, Maryland

Johns Hopkins University
Rockville, Maryland

Metro Baltimore Lab Market

Existing Lab Space			
	Total SF	Available SF (Vacant/ Sublease)	Availability Rate
Baltimore City	665,100	73,500	11.1%
Baltimore County	248,500	23,000	9.3%
BWI	32,200	0	0%
Columbia	231,461	123,636	53.4%
Total Leased Space	**1,177,261**	**220,136**	**18.7%**
Total Owner Occupied	1,573,602		
Total Combined	**2,750,863**	**220,136**	**18.7%**
Total Future Lab Space	**2,720,000**		

Baltimore and the surrounding region support the life science industry with more than 200 private labs and numerous government or nonprofit research centers totaling over 2.7 million square feet of space. The majority of life science activity in the region is university-related, and much of the existing space is thus tied to JHU or UMB on the east and west ends of the city, respectively. Demand for commercial lab space has been generally improving, though most active tenants are relatively small in size and space needs.

Market Asking Rents	
	Asking Rent PSF
Baltimore City/ Baltimore County	$19 - $33 NNN
BWI/Columbia	$15 - $20 NNN

Baltimore Lab Outlook

With several exciting new developments on the horizon, demand for lab space is expected to improve in 2004. Two new major biotech developments will help shape the future of Baltimore's life science market. JHU and UMB, both ranked nationally among the best hospitals and leading academic research institutions in the nation, will anchor these two biotech developments. The largest future development is the East Baltimore Life Sciences and Technology Park, which will be anchored by JHU. This ten-year master plan will consist of two phases in 2.0 million square feet of biotech space on 20 acres. The first 200,000 square foot lab building is planned for delivery in the spring of 2005. This project required $800 million in private and public funds. The eight-building, 750,000 square foot UMB Biomedical Research Park will deliver its first lab building at the end of 2004. This $300 million investment will serve as a bioscience incubator for startups.

In addition, major Federal investment on two other campuses will drive future spin-off opportunities. The new NIH facility at Johns Hopkins Bayview Campus, a 550,000 square-foot lab building, is scheduled for delivery in 2006. The primary occupants will be NIH Institutes on Aging and Drug Abuse. Located at the Aberdeen Proving Ground, the $44 million Agent Chemistry Laboratory at the Edgewood Chemical and Biological Center was recently constructed. There is an additional request for $13 million in order to build a new facility, which would handle agents.

Incentives

Both Maryland and Virginia have undertaken efforts to address workforce, tax code, financing, R&D, commercialization, and industry facility issues that are important to life science firms. Below are some of the public and private organizations that provide support services, economic development, and incentives.

Maryland

- Maryland Department of Business and Economic Development
- MDBio
- The Maryland Bioscience Alliance

Virginia

- Virginia's Center for Innovative Technology
- The Virginia Department of Business Assistance
- The Virginia Economic Development Partnership
- The Virginia Biotechnology Research Park Authority
- Virginia Small Business Incubator Grant Program
- Commonwealth Technology Research Fund
- The Virginia Biotechnology Association

Source: "State Government and Biotechnology 2001," Battelle Memorial Institute, www.bio.org/tax/battelle.pdf

RALEIGH-DURHAM

DID YOU KNOW?

NORTH CAROLINA LAYS CLAIM TO THE WORLD'S LARGEST BIOLOGICS MANUFACTURING FACILITY (BIOGEN IDEC), THE LARGEST VACCINE FACILITY (WYETH) AND THE LARGEST PLASMA-BASED PRODUCTS FACILITY (BAYER).

MARKET OVERVIEW

The Raleigh-Durham area in North Carolina, referred to as "Research Triangle," is the established life science hub of the South, with particular focus on manufacturing and biotechnology. The region's epicenter has been and continues to be the internationally-renowned 7,000-acre Research Triangle Park *(RTP)*, which features the world's largest concentration of Contract Research Organizations *(CROs)* and numerous prominent life science companies as tenants. RTP is at the center of the Raleigh-Durham life science cluster, which stretches from Raleigh northwest to Durham and then southwest to Chapel Hill. "Big Pharma" arrived in the 70's and 80's with Burroughs Wellcome and Glaxo, helping pave the way for a new influx of R&D and biomanufacturing companies such as Biogen Idec, Diosynth and Eisai. The area's life science real estate market has grown proportionally with the immigration of more life science and biomanufacturing companies. Recent development in Research Triangle has provided new space options for tenants, though the market overall remains competitive.

INDUSTRY DRIVERS

Research Triangle has a solid base of research universities, hospitals, and funding that provide the fundamentals for a successful life science cluster. The area's universities are home to cutting edge research that produces new technologies and emerging companies, which in the 1990s were granted nearly 800 patents for their research.

In 2003, Duke University received $346 million and University of North Carolina received $271 million, ranking 10th and 18th, respectively, among institutions receiving NIH funding that year. Despite the challenging private funding environment of 2003, Triangle area life science companies also received more than $100 million in venture backing, according to PricewaterhouseCoopers MoneyTree Report for 2003.

University of North Carolina at Chapel Hill, Duke University in Durham and North Carolina State University in Raleigh each offers a life science Ph.D. program in addition to annually providing a steady supply of well-educated graduates to the work force.

MAJOR PLAYERS

The biomanufacturing industry enjoys a strong base at RTP led by GlaxoSmithKline and Biogen Idec. In the past dozen years, the number of RTP life science companies specializing in therapeutics, diagnostics, genomics, bioinformatics, contract research and manufacturing has more than doubled. The concentration of these companies has created a diverse marketplace featuring over 120 biotechnology companies of all sizes and 70 contract research and testing companies that combine to generate over $3 billion in annual revenues.

Duke and UNC Chapel Hill both maintain nationally-acclaimed clinical teaching hospitals on their campuses, and the facilities are available to and active in local life science studies and trials. According to a U.S. News report on the country's top hospitals, Duke University Medical Center ranked 6th overall, while University of North Carolina Hospital ranked within the top thirty in each category analyzed in the report.

INDUSTRY DRIVERS*

INDUSTRY DRIVERS	TOTAL	RANK**
Life Scientists 1998	>900	9
NIH Funding 2002 *(in millions)*	$745	8
Venture Capital Funding for Biotech Companies 2003 *(in millions)*	$109	6
Biotechnology Patents *(1990-1999)*	796	7
Number of Biotechnology Companies 2002	87	6

Major Players

Major Institutions

Academic Research/ Medical	Clinical Teaching Hospitals	Independent Research Institutions
Duke University	Duke University Medical Center	CIIT Centers for Health Research
North Carolina Central University	University of North Carolina Hospital	National Institute of Environmental and Health Studies
North Carolina State University		Research Triangle Institute
University of North Carolina at Chapel Hill		

Major Sector Players

Pharmaceutical Companies	Biotechnology Companies	Medical Device Companies
Bayer CropScience *Clayton*	Biogen Idec *RTP*	Bristol-Myers Squibb *Greensboro*
Eli Lilly and Company *RTP*	Gilead Science *Durham*	Closure Medical Corporation *Raleigh*
EMD Pharmaceuticals *Durham*	Paradigm Genetics, Inc. *Research Triangle Park*	Polyzen, Inc. *Apex*
GlaxoSmithKline *RTP*	Trimeris, Inc. *Durham*	Sicel Technologies, Inc. *Morrisville*

Lab Market Snapshot

The Research Triangle lab market, inclusive of owned and leased R&D space, consists of approximately 9.1 million square feet of space. Research Triangle Park and the immediate area around RTP, referred to as the RTP/I-40 submarket, totals more than 8.5 million square feet, accounting for 94% of the region's total lab space supply. The remainder of the lab space is located in facilities dispersed throughout Wake, Durham and Orange Counties.

Existing Lab Space

	Total SF	Available SF (Vacant+ Sublease)	Availability Rate
RTP/I-40 Submarket	8,557,928	613,403	7.2%
Other Submarkets	568,983	51,424	9.0%
Overall Inventory	**9,126,911**	**664,827**	**7.3%**

Approximately 664,827 square feet of space is currently vacant *(7.3%)*, however over 50% of this vacant space is located in the 354,000 square foot Triangle Life Science Center *(TLS)* facility, formerly occupied by the Environmental Protection Agency, at RTP. The developers of TLS are seeking large users at this time; although TLS features significant infrastructure and a tremendous location, the facility will require major renovations to accommodate most lab tenants. Excluding this project, vacant space totals only approximately 270,000 square feet, equating to a vacancy factor of just 3.4%.

Market Asking Rents

	Asking Rent PSF	TI Allowance PSF
Modern/well-equipped	$24 - $30 NNN	$40 - $60
Renovated office/ shell-condition	$18 - $23 NNN	$60 - $100
Second-generation	$13 - $17 NNN	$20 - $30

Asking rents for lab space in Research Triangle vary significantly depending upon the class of space, the degree of lab improvements, the length of the lease term and the project scale. Tenant improvement allowances vary depending upon the lease term, the creditworthiness of the tenant and the existing conditions of the space. Total operating expenses will vary from approximately $7.50 to $11 per square foot depending on the intensity of the laboratory fit-up and the utility usage. Given the expense and unique nature of most life science fit-ups, landlords scrutinize the creditworthiness of less-established life science users. Small to mid-sized companies often must provide a Letter of Credit or other forms of security deposit and may be asked to fund some of their tenant improvements.

Recent Transactions

Tenant	Building Address	Town	Size (SF)
Wyeth	407 Davis Drive	Durham	80,000
AlphaVax	2810 Meridian Parkway	Durham	17,500 *(expansion)*

Recent transactions of note include Wyeth's lease of 80,000 square feet of single-story office/flex space, which included conversion of approximately 40% of the facility to laboratory space. AlphaVax also expanded with a lease of 17,500 square feet of second-generation lab and pilot plant space in the RTP submarket, which they plan to upgrade with investment of $2 to $3 million of their own funds.

Market Outlook

Leasing activity by small and mid-sized companies has increased over the end of 2003 into 2004, after a dismal 24 months. Overall leasing activity is expected to continue to increase steadily during the next 18-24 months.

The difficulty of finding quality lab space has subsided over the past six months as two new speculative lab buildings were developed in RTP adding over 80,000 square feet. In addition, Pharmaceutical Product Development *(PPD)* put its state-of-the-art 61,603 square foot facility at Perimeter Park on the market for sublease. Future development plans include the Triangle Biotechnology Center at Venable, which is a proposed renovation of the 100,000 square foot former Venable Tobacco warehouse building near downtown Durham and Duke University. Merck & Co. recently announced that it plans to purchase 256 acres in North Durham for construction of a $300 million dollar vaccine manufacturing plant. Andrx Corporation also purchased a 500,000 square foot pharmaceutical manufacturing plant in Morrisville from Bristol-Myers and plans to invest $87 million in renovations in order to be operational in 2005.

Incentives

Raleigh-Durham has a long history of supporting and facilitating the development of the state's life science community. Below are some of the public and private organizations that provide support services, economic development, and incentives.

- North Carolina Biotechnology Center
- North Carolina Bioscience Investment Fund
- Innovation Research Fund
- Collaborative Funding Assistance Grants Program
- North Carolina Biosciences Organization
- Council for Entrepreneurial Development

Pharmaceutical Product Development Sublease Space
3500 Paramount Parkway / Morrisville, NC

Source: "State Government and Biotechnology 2001," Battelle Memorial Institute, www.bio.org/tax/battelle.pdf

SEATTLE

DID YOU KNOW

SCIENTISTS AT FRED HUTCHINSON CANCER RESEARCH CENTER WERE THE FIRST TO SHOW THAT PATIENTS WITH ACUTE LEUKEMIA WHO HAVE FAILED CHEMOTHERAPY CAN BE CURED WITH MARROW TRANSPLANTATION.

Source: Fred Hutchinson Cancer Research Center, www.fhcrc.org

MARKET OVERVIEW

The Puget Sound area is a dense biotechnology cluster with over 175 biotech and medical technology companies, many of which were spin-offs from research conducted at nearby institutions, the University of Washington *(UW)* and the Fred Hutchinson Cancer Center. The region's biomedical research activity dates back to the founding of Genetic Systems Co. and Immunex Corp. *(acquired by Amgen in 2001)*, both established in the early 1980s and considered the region's largest biotech companies. In addition, two researchers from UW and a collaborator from British Columbia established the area's other revolutionary biotech company, ZymoGenetics, Inc., in 1981.

Approximately 95% of Seattle's biotech companies are located either in Seattle or the greater Eastside with an even split between the two sides of Lake Washington.

INDUSTRY DRIVERS

In 2003, UW ranked 3rd nationally among all NIH-funded institutions, receiving over $440 million in grants. In 2002, the Fred Hutchinson Cancer Research Center ranked 2nd in NIH support to independent research institutes, receiving over $100 million. On the private funding side, Seattle biotech companies received almost $90 million in venture backing according to Pricewaterhouse Coopers MoneyTree Report for 2003.

MAJOR PLAYERS

Two very powerful drivers of all biotech activity in the area, UW and the Fred Hutchinson Cancer Research Center, are national leaders in medical research. UW is consistently among the top three schools in the nation in grant money and the Fred Hutchinson Cancer Research Center has been a leader in cancer research, fueling the commercialization of many of its research findings. Both institutions have spawned numerous companies and are included in joint ventures with many of the area's private life science companies.

Paul Allen, the billionaire co-founder of Microsoft Corporation, and his investment firm, Vulcan, Inc., have assembled 50 acres of land in South Lake Union, just blocks from the Seattle Center, for a mixed-use development anchored by a biotechnology park. UW is proposing a medical research campus that could ultimately cover two full blocks of the South Lake Union neighborhood, pharmaceutical giant Merck & Co. has leased one of the buildings under construction, and the Seattle Biomedical Research Institute and the research arm of Children's Hospital and Regional Medical Center occupy another.

INDUSTRY DRIVERS*

INDUSTRY DRIVERS	TOTAL	RANK**
Life Scientists 1998	>1,800	6
NIH Funding 2002 *(in millions)*	$642	8
Venture Capital Funding for Biotech Companies 2003 *(in millions)*	$89	T8
Biotechnology Patents *(1990-1999)*	770	8
Number of Biotechnology Companies 2002	50	9

Major Players

Major Institutions

Academic Research/ Medical	Clinical Teaching Hospitals	Independent Research Institutions
University of Washington	Children's Hospital and Regional Medical Center	Fred Hutchinson Cancer Research Center
	University of Washington Harborview Medical Center	Hope Heart Institute for Systems Biology
		Pacific Northwest National Laboratory
		Seattle Biomedical Research Institute

Major Sector Players

Pharmaceutical Companies	Biotechnology Companies	Medical Device Companies
Merck & Company *Rosetta*	Amgen, Inc. *Seattle*	Medtronic, Inc. *Redmond*
	Cell Therapeutics, Inc. *Seattle*	Siemens *Seattle*
	Corixa Corporation *Seattle*	
	Dendreon Corporation *Seattle*	
	Icos Corporation *Bothell*	
	NeoRx Corporation *Seattle*	
	Targeted Genetics Corporation *Seattle*	
	Xcyte Therapies, Inc. *Seattle*	
	ZymoGenetics, Inc. *Seattle*	

Lab Market Snapshot

Biotechnology and medical technology firms in the Seattle area occupy over 3.0 million square feet of facilities. Seven of the 10 largest biotech firms are located in Seattle, as are most new developments due to the proximity of the Fred Hutchinson Cancer Research Center and UW. Amgen will occupy the first phase of their new campus in the Interbay area next spring, however since Amgen purchased Immunex in 2001, their growth has slowed slightly and future growth is uncertain in Seattle.

Medical device companies typically need warehouse space once they reach the manufacturing stage. Thus, the medical technology firms have traditionally located in Redmond or Bothell on the Eastside, where flex space is more prevalent. Recently, many early stage medical technology companies have located in Seattle's "Denny Regrade," the area stretching north of the central business district which was forcibly flattened early in the twentieth century.

Existing Lab Space

	Total SF	Available SF (Vacant/ Sublease)	Availability Rate
Total Leased Space	3,275,103	223,044	6.8%
Total Future Lab Space	690,264		

While the overall vacancy rate is about 16% for the Puget Sound area, the lab market remains very tight at below 7%. For years there has been a shortage of lab space in the region, and traditionally tenants have had to develop their own buildings or retrofit existing office buildings to accommodate growth.

Market Asking Rents

	Asking Rent PSF	TI Allowance PSF
Submarket	$45 - $65 NNN	$150 - $175
Second Generation Space	$20 - $50 NNN	$0 - $25

Rental rates for new projects are running $45-$65 per square foot NNN, which includes the amortization of approximately $150-175 per square foot in tenant improvement allowance needed to build the labs. Projects in Seattle are closer to $60 per square foot NNN, while new space can be had in Bothell for closer to $45 per square foot NNN. The difference is in land prices: it is possible to build-out tilt-up buildings in Bothell, while new buildings in Seattle generally have a cost basis of $30 per square foot NNN for a new shell building.

South Lake Union Development
Seattle, WA

What's Hot

Seattle is in the midst of a new development cycle targeting biotech. There are currently six projects that are either planned and permitted, under construction or just completed. All are located in Seattle and, upon completion, will add a total of 2.0 million square feet of lab space to the market. The South Lake Union campus has received the most attention. In March of 2004, Seattle Biomedical Research Institute (SBRI) moved into the SBRI Building, a 112,000 sf, five-story, state-of-the-art research and office building located at 307 Westlake. SBRI occupies the top two floors of the building, totaling 56,000 sf and researchers from Children's Hospital and Regional Medical Center are leasing more than 47,000 sf on the second and third floors for a number of research programs, including infectious diseases, immunology, rheumatology, hematology, oncology, nephrology and genetics. In February of 2004, Rosetta Inpharmatics/ Merck moved into a new 133,000 sf research facility in South Lake Union, and it is rumored that their requirement in that area will double in the next five years. The UW Medicine will move into a 105,000 sf research facility in late 2004, adding to their current South Lake Union presence in the Rosen Building, and may eventually occupy up to 750,000 sf in the neighborhood. There are currently four buildings in South Lake Union that are permitted and ready for pre-leasing and two under construction.

Recent Transactions

Tenant	Town	Size (SF)
Ceptyr, Inc. Bothell 35,000 SF Icos Corporation	Bellevue	30,000
Children's Hospital and Regional Medical Center	Seattle	40,000
GeneCraft, Inc.	Seattle	29,000
SeattleBiomedical Research Institute	Seattle	55,000
ZymoGenetics, Inc.	Seattle	130,000

There is almost no second-generation space available in Seattle today. Amgen is expected to vacate close to 100,000 square feet of lab space within three buildings sometime in the middle of next year. Rates for existing labs depend on the age and quality of the lab.

An estimated 24 major real estate transactions occurred in the Seattle life science market during 2002 and 2003, including five of the region's eight largest real estate transactions in the last year and a half.

Incentives

Although there is no explicit state government life science strategy, the Washington Biotechnology and Biomedical Association is working with the state to formulate and implement a strategy, which would encourage the growth of companies and their research. Below are some of the public and private organizations that provide support services, economic development, and incentives.

- The Washington Technology Center *(WTC)*
- The Advanced Technology Initiative
- WTC's Research and Technology Development Program
- Washington Biotechnology and Biomedical Association

Source: "State Government and Biotechnology 2001," Battelle Memorial Institute, www.bio.org/tax/battelle.pdf

Future Developments

Project	Size	Comments
South Lake Union	1,000,000+ SF	Five buildings permitted
Amgen/Helix Campus	500,000+ SF	Occupy Phase 1 in early 2004
Providence Hospital/1910 Bldg.	300,000 SF	Target 2005 occupancy
9th & Stewart	200,000 SF	70% pre-leased to Corixa Corp.
1616 Eastlake	175,000 SF	Available
11th & Columbia	125,000 SF	In permitting stage

SAN FRANCISCO

WHAT'S HOT

New scientific challenges require major upgrades to physical environments. UCSF is in the first phase of a 15-year, $1.5 billion building boom, the largest university expansion in history. A 43-acre second campus called *Mission Bay* is rising south of downtown San Francisco, replacing old railyards and abandoned warehouses with state-of-the-art research facilities. In this environment, scientists will combine physical science and biology with computational research to study some of the most complex biological processes, such as how genes, proteins, and chemical signals interact with one another and with pathogens in the genesis of disease. This work promises to lead to new drug-development as well as to innovation in the area of disease management and prevention.

MARKET OVERVIEW

The San Francisco Bay Area lab market is comprised of four submarkets, South San Francisco, Downtown San Francisco, Peninsula/Silicon Valley and the East and North Bay region. The modern US biotechnology industry was born in the Bay Area with the formation of Genentech in 1976, and has been expanding ever since, The area has the highest critical mass of biotech business expertise, biotech trained labor force, collaborative academic and research institution network, and locally developed intellectual property in the world. Additionally, according to the Brookings Institution, the Bay Area is among the most entrepreneurial regions among the nine clusters studied.

San Francisco Bay is rich with academic and research facilities that are continually adding life science facilities and spinning off intellectual property into the commercial market. Stanford University has added such facilities as the Beckman Center and the recently completed multi-disciplinary Clark Center *(above)*. Also, the University of California San Francisco *(UCSF)* has opened a major new biotech-focused campus in San Francisco.

INDUSTRY DRIVERS

The thriving biotech market in the Bay Area is fueled by a fertile supply of entrepreneurs with a balance of business experience and academic research credentials. The San Francisco Bay area employs about 85,000 workers in the life science industry, over 3,000 of whom can be considered life scientists.

Silicon Valley continues to have the largest concentration of venture capital investors in the world, as well as the greatest number of highly-active biotech investors. Funding of new biotech companies has started to accelerate in 2004 compared to the past two years. Most of these companies are being funded in the $5 to $20 million range, although Corgentech raised $98 million in early 2004 in a public offering and Connetics raised $61 million in a private placement.

A mix of both private firms and public institutions accounted for the majority of the increase in biotechnology patenting in the region during the 1990's. Genentech and Incyte Pharmaceuticals are the two private corporations that held the most biotechnology patents in the 1990s, receiving over 600 patents combined.

MAJOR PLAYERS

In 2003, Stanford University, University of California at Berkeley and UCSF received more than $804 million combined in NIH funding, with UCSF ranking as the fourth-highest institutional recipient of NIH support nationally for the second year in a row. These academic institutions proactively encourage spin-off and commercialization of biotechnologies and most major biotech companies have operations in the area. Virtually all leading-edge biotechnologies and concepts are in development by one or more established companies or any of the several hundred companies funded by private and venture capital resources in the Bay Area.

INDUSTRY DRIVERS*

INDUSTRY DRIVERS	TOTAL	RANK**
Life Scientists 1998	>3,600	4
NIH Funding 2002 *(in millions)*	$861	5
Venture Capital Funding for Biotech Companies 2003 *(in millions)*	$819	1
Biotechnology Patents *(1990-1999)*	3,991	2
Number of Biotechnology Companies 2002	226	2

Major Players

Major Institutions

Academic Research/ Medical

Cal State University, Hayward

San Francisco State University

San Jose State University

Stanford University

University of California, Berkeley

University of California, Davis

University of California, San Francisco

Clinical Teaching Hospitals

Stanford University Hospital

University of California, San Francisco Medical Center

Independent Research Institutions

California Pacific Medical Center Research Institute

Children's Hospital Oakland Research Institute

J. David Gladstone Institutes

Northern California Institute for Research and Education

Palo Alto Medical Foundation Research Institute

Public Health Institute

Smith-Kettlewell Eye Research Institute

Major Sector Players

Pharmaceutical Companies

Alza Corporation *Mountain View*

Berlex Laboratories, Inc. *Richmond*

Roche *Palo Alto*

Biotechnology Companies

Abgenix *Fremont*

Affymax, Inc. *Palo Alto*

Aradigm Corporation *Hayward*

Celera Genomics *South San Francisco*

Cell Genesys Inc. *South San Francisco*

Chiron Corporation *Emeryville*

CV Therapeutics *Palo Alto*

Elan Pharmaceuticals *South San Francisco*

Genencor International *Palo Alto*

Genentech, Inc. *South San Francisco*

Geron Corporation *Menlo Park*

Gilead Sciences *Foster City*

Incyte Corporation *Palo Alto*

InterMune Inc. *Brisbane*

Nektar Therapeutics *San Carlos*

Onyx Pharmaceuticals *Richmond*

Scios, Inc. *Fremont*

Medical Device Companies

Affymetrix, Inc. *Santa Clara*

Agilent Technologies *Palo Alto*

Applied Biosystems *Foster City*

Avigen, Inc. *Alameda*

Caliper Technologies *Mountain View*

Ciphergen Biosystems *Fremont*

Lab Market Snapshot

Existing Lab Space			
	Total SF	Available SF (Vacant/ Sublease)	Availability Rate
Total Leased Space	11,500,000	1,525,000	13.3%
Total Owner Occupied	6,100,000		
Total Combined	**17,600,000**		
Total Future Lab Space	**1,400,000**		

The San Francisco market is comprised of approximately 17.6 million square feet of existing lab space. Within the four submarkets in the San Francisco Bay Area lab market, there is substantial vacancy of second generation facilities where companies have either run out of money, or were acquired by firms which took local operations elsewhere. There is approximately 1.5 million square feet available in facilities with second generation biotech space, however there is not a lot of directly-competitive space in the market with respect to size and build-out. In some cases, owners have removed older or marginal quality wet labs, and returned the space to general R&D use.

Market Asking Rents		
	Asking Rent PSF	TI Allowance PSF
South San Francisco	$25 - $50 NNN	$0 - $50
Downtown San Francisco	$25 - $45 NNN	$10 - $50
Peninsula/Silicon Valley	$11 - $42 NNN	$0 - $40
East and North Bays	$15 - $45 NNN	$0 - $40

South San Francisco, anchored by the Genentech campus, is San Francisco's biotechnology epicenter. This submarket has the highest density of biotech facilities, many of which are modern and designed with infrastructure to meet specific biotech lab requirements. The market has been impacted by a substantial amount of sublease space with existing $100+ per square foot Class A build-outs where previous tenants ran out of funds before operations began. The three-building Sugen campus was barely completed with Class A extensive biotech build-out when operations ceased and the campus was placed on the market. Such facilities often are specialized and do not divide easily to the generic size and build-out many venture-funded startups need.

In **Downtown San Francisco,** the majority of previous dot-com warehouse facilities have been converted to creative R&D space, however the area is not yet a biotechnology center. The city has aggressively been trying to develop a waterfront shipping area as a biotech hub. The Mission Bay project, anchored by the 43-acre UCSF biotech center, is designed to lease or sell surrounding facilities to biotech companies who would draw on UCSF resources. Unfortunately, this project began just as the dot-com pandemonium broke, and Downtown San Francisco has not yet been successful in attracting a major critical mass of new biotech companies.

Recent Transactions		
Tenant	Town	Size (SF)
Abgenix	Fremont	50,688
California Pacific Medical	San Francisco	42,000
Renovis	South San Francisco	71,000

Peninsula/Silicon Valley: Moving south down the peninsula through San Mateo County and then from Palo Alto down to San Jose, there is a substantial presence of the biotech industry, although not as dense as in South San Francisco. Abbott Laboratories has locations throughout the area and purchased land in Redwood City two years ago for a planned 1.0 million square foot campus. A broad range of drug development and medical device companies are also prevalent throughout the area. Just before ceasing operations, Deltagen completed a build-out in a 100,000 square foot facility which included over 25,000 square feet of vivarium space. Many existing biotech facilities in the Peninsula submarket are second generation Class B facilities originally designed for general R&D, with rent in the range of $11- $25 per square feet NNN.

The East Bay and North Bay lab market encloses the east side of the bay from Newark to the Alameda/ Oakland area. Most biotech companies scattered throughout the area are privately-funded. There are very few building owners that would front the improvement costs for an extensive biotech build-out. To the north toward the Berkeley/Richmond area, there are additional pockets of biotech companies. The presence of University of California campuses, including Berkeley, provide solid academic and research resources that attract a range of biotech firms.

Market Outlook

The vacancy rate should decrease over the next one to two years. Newly-funded companies are not as likely as they were in 1998-2001 to have the capital necessary to perform expensive space build-outs. Fewer building owners will take the chance to front tenant improvement costs, which are not recoverable as rent if the company does not survive. Biotech companies without an established business base will have to lower expectations of occupying newer lab facilities or they will have to find a new source of capital to fund biotech build-outs. Communities will continue to proactively solicit biotech companies and will often assist in construction approvals. Biotech incubators are a popular concept, but these are primarily for small startups and are not likely to be successful in attracting a critical mass of larger companies to the area.

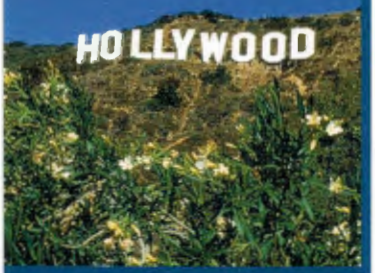
Incentives

California continues to be a strong supporter of the life science industry, promoting collaboration between the area's universities and companies. Below are some of the public and private organizations that provide support services, economic development, and incentives.

- Institute for Bioengineering, Biotechnology and Quantitative Biomedical Research
- California Biotechnology Program
- The California Healthcare Institute
- Biotechnology Strategic Targets for Alliances in Research *(BioStar)* Program
- California Technology Investment Partnership

Source: "State Government and Biotechnology 2001," Battelle Memorial Institute, www.bio.org/tax/battelle.pdf

LOS ANGELES



DID YOU KNOW

THE TECHNOLOGY BEHIND THE MACHINES THAT DECODE DNA, THE INSTRUMENTS THAT HAVE BEEN VITAL TO UNLOCKING THE SECRETS OF GENETICS, WAS DEVELOPED IN THE 1980S BY SCIENTISTS AT CALIFORNIA INSTITUTE OF TECHNOLOGY.

MARKET OVERVIEW

The Los Angeles Basin lab market is comprised of Los Angeles, Ventura and Orange Counties. The area has a significant life science presence, although it has not yet realized its potential given the sheer size of the local economy, the presence of a number of premier universities, hospitals and independent research institutions, and the large concentration of college graduates in the area. The Los Angeles life science industry has a general emphasis on medical-device firms. With the notable exception of a handful of major pharmaceutical companies, there is a relative absence of large pharmaceutical operations. There are, however, a large number of small spin-offs associated with research activity at the area's major universities and research institutions. These companies are rapidly expanding, and the outlook is for strong growth.

INDUSTRY DRIVERS

The seven major universities in the Los Angeles Basin graduate approximately 220 life science Ph.D.s per year. In addition, the LA Basin existing labor force boasts one of the largest concentrations of college grads in the world: 2.5 million individuals, including 95,000 with Ph.D.s.

The NIH provided 1,926 grants of financial support to the Los Angeles Basin totaling approximately $747 million in 2002. In 2003, the University of California at Los Angeles *(UCLA)* was ranked 9th nationally among the institutions receiving NIH funding with $347 million in grants, the University of Southern California was 34th with $167 million, and the University of California at Irvine was 53rd on the list with $111 million in grants.

A mix of both private companies and public institutions accounted for the majority of the increase in biotechnology patenting in the region during the 1990s. Allergan, Inc., a global specialty pharmaceutical company, and the University of California, are among the top organizational patent holders in the region, receiving a combined total of over 300 patents throughout the 1990s.

MAJOR PLAYERS

Colliers International has identified a total of 800 companies in the Los Angeles Basin involved in the life sciences. Amgen, headquartered in Thousand Oaks, is one of the world's largest biotechnology companies. Amgen anchors the sector with a staff of nearly 13,000 in Thousand Oaks and a total revenue projection for 2004 of $10 billion. Allergan, headquartered near University of California at Irvine, has revenues projected at $1.9 billion for 2004, and a staff that totals 5,000. American Pharmaceutical Partners, a specialty pharmaceuticals and generic injectable developer, is headquartered in Los Angeles and has 2003 sales of $351.3 million.

Two of the seven major research institutions in the Los Angeles Basin are ranked nationally in the top twenty for life science research. Most of the major universities in the region also have large hospital operations associated with them. The Los Angeles Basin has one highly acclaimed hospital, the UCLA Medical Center. According to a US News report on the country's top hospitals, the UCLA Medical Center was ranked fifth in the nation.

INDUSTRY DRIVERS*

INDUSTRY DRIVERS	TOTAL	RANK**
Life Scientists 1998	>2,450	5
NIH Funding 2002 *(in millions)*	$747	7
Venture Capital Funding for Biotech Companies 2003 *(in millions)*	$89	T8
Biotechnology Patents *(1990-1999)*	1,399	6
Number of Biotechnology Companies 2002	76	7

Major Players

MAJOR INSTITUTIONS

Academic Research/ Medical	Clinical Teaching Hospitals	Independent Research Institutions
California Institute of Technology	Cedars Sinai Medical Center	City of Hope Beckman Research Institute
University of California, Irvine	Children's Hospital of Los Angeles	Huntington Medical Research Institute
University of California, Los Angeles	Kaiser Foundation Hospital	
University of California, Santa Barbara	Los Angeles County - Harbor - UCLA Medical Center	
University of Southern California	Los Angeles County – USC Medical Center	
	Rancho Los Amigos National Rehabilitation Center	
	UCLA Medical Center	
	UCLA Neuropsychiatric Hosptial	
	USC University Hospital	

MAJOR SECTOR PLAYERS

Pharmaceutical Companies	Biotechnology Companies	Medical Device Companies
Abbott Laboratories	American Pharmaceutical Partners	AMDL
Allergan, Inc.	Amgen, Inc. (biopharma)	Baxter International, Inc
ISTA Pharmaceuticals		Beckman Coulter, Inc.
Miravant Medical Technologies		BioSource International
Sicor		Diagnostic Products Corporation
Watson Pharmaceuticals		Edwards Lifescience Corporation
		Hycor Biomedical

City of Hope's Beckman Research Institute supports innovative and creative research and educates future scientists in the biological sciences. The close interaction between Beckman scientists and City of Hope physicians provides unique opportunities for translational research, allowing basic science to be quickly developed into life-saving treatments or cures. Huntington Medical Research Institutes *(HMRI)* was founded in 1952 and operates in five locations in Pasadena, California. HMRI is an independent, nonprofit, public-benefit organization dedicated to improving health and prolonging life by enhancing knowledge of life processes and disease, and by developing technology to diagnose and treat diseases.

Lab Market Snapshot

The Los Angeles Basin lab market is comprised of approximately 4.5 million square feet, dispersed across 101 buildings. Growth in supply has been relatively restrained; the base has increased by only 20% since 1995.

Existing Lab Space

	Total SF	Available SF (Vacant/ Sublease)	Availability Rate
Los Angeles County	2,161,440		
Ventura County	405,270		
Orange County	1,936,290		
Total Leased Space	**4,503,000**	**333,222**	**7.4%**

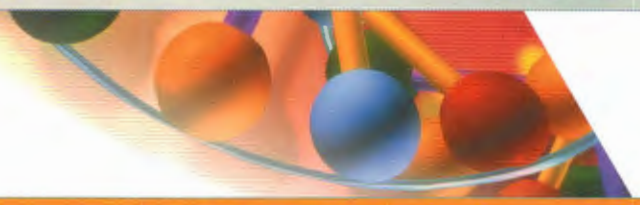
Demand has been moderate in recent years, with positive net absorption of 253,000 square feet total over the past three years. However, most of that took place in 2002, and net absorption in 2003 was negative 37,000 square feet. Construction activity has been restrained due to a lack of existing lab space and few sophisticated life science landlords who understand the industry. Most companies have been forced to build out and/or renovate facilities in order to create their own lab space. The total availability rate for lab space *(including sublet space)* is just 7.4% for the area. This is significantly lower than the overall availability rate for office space in the Los Angeles Basin of 17.1%, and somewhat lower than the overall availability rate for R&D space of 9.1%.

Unlike many of the other major life science clusters, the Los Angeles Basin, most likely due to its sprawling nature, does not have one particular area or congregation of life science companies. 48% of the space is in Los Angeles County, primarily in the San Fernando, Conejo, Santa Clarita and San Gabriel Valleys, all to the north of downtown Los Angeles. An additional 9% is in the immediately-adjacent Thousand Oaks portion of Ventura County. The remaining 43% is in Orange County, primarily in the South County area near University of California at Irvine.

Market Asking Rents

	Asking Rent psf	TI Allowance psf
Los Angeles	$25 - $30 NNN	$25 - $50
Ventura	$25 - $30 NNN	$25 - $50
Orange	$30 - $36 NNN	$25 - $50

Tenant Improvement costs for lab space range between $75 and $125 per square foot, although many landlords will not fund all of that cost. The annual rental rates are averaging between $25 and $36 NNN per square foot, with rents generally at the low end of the range in Los Angeles and Ventura Counties and at the upper end of the range in Orange County.



Recent Transactions

Tenant	Town	Size (SF)
Specialty Laboratories, Inc.	Valencia	198,000 *(leaseback)*
Watson Laboratories, Inc.	Corona	194,000

Market Outlook

Interest in future requirements has been picking up recently and demand is projected to increase in the remainder of 2004 and into 2005. Driving this growth in demand is a strengthening economy *(the number of employed residents in the Los Angeles Basin grew by 138,000 or 1.6% in the 12-month period ending February 2004, for a rate greatly outpacing the nation)*, a concentration in the Los Angeles Basin of a large number of small startup firms who continue to expand, generally strong growth projected industry-wide for life sciences, and the definite potential for the Los Angeles Basin to increase its market share of the national activity, particularly in the pharmaceutical segment. Construction of lab space remains minimal, suggesting that the market is likely to remain a landlord's market through year-end 2005.

Incentives

California continues to be a strong supporter of the life science industry, promoting collaboration between the area's universities and companies. Below are some of the public and private organizations that provide support services, economic development, and incentives.

- Institute for Bioengineering, Biotechnology and Quantitative Biomedical Research
- The California Biotechnology Program
- The California Healthcare Institute
- Biotechnology Strategic Targets for Alliances in Research *(BioStar)* Program
- California Technology Investment Partnership
- The Southern California Biomedical Council *(SCBC)*

Source: "State Government and Biotechnology 2001," Battelle Memorial Institute, www.bio.org/tax/battelle.pdf

Amgen • Thousand Oaks, CA

Amgen, the largest United States biotech firm, is headquartered in Thousand Oaks, approximately 30 miles northwest of downtown Los Angeles. Amgen's research and product development programs aim to help patients in the following therapeutic areas: oncology, inflammation, hematology and nephrology, neurology, and metabolic disorders and osteoporosis. The company began operations in 1981 and chose Thousand Oaks as its headquarters to be near major research centers including UCLA, the University of California at Santa Barbara, and California Institute of Technology. In addition to housing the company headquarters, Amgen's Thousand Oaks site plays host to the company's drug discovery facilities, clinical development facilities, pure bulk manufacturing plants, and distribution facilities.

AMGEN THE LARGEST U.S. BIOTECH FIRM

SAN DIEGO

DID YOU KNOW

RESEARCHERS AT THE SCRIPPS RESEARCH INSTITUTE PIONEERED THE DETERMINATION OF THE COMPLETE, THREE-DIMENSIONAL, ATOMIC STRUCTURE OF THE POLIO VIRUS.

MARKET OVERVIEW

San Diego is one of the nation's premier biotechnology markets, anchored by prominent nonprofit medical research institutions and R&D-oriented private companies. The life science industry in San Diego dates back to the 1960s. In 1964, San Diego designated Torrey Pines Mesa as an area for "scientific research and development activities," limiting manufacturing to "prototype fabrication and/or production of products requiring advanced technology and skills directly related to research and development activities on the premises." In the 1970s, two University of California San Diego *(UCSD)* researchers spun out the private company Hybritech, Inc., which pioneered the commercial use of monoclonal antibodies. Hybritech was later purchased by Eli Lilly, but its alumni went on to start up an estimated 40 biotech companies in the San Diego Metropolitan area, according to the Brookings Institution. The region's entrepreneurial spirit and past success have helped to create significant life science resources, supporting capital sources and service networks. The 9.6 million square foot San Diego lab market is concentrated in the Torrey Pines submarket, with several supporting submarkets.

INDUSTRY DRIVERS

The Torrey Pines area is rich with world-class research institutions, outstanding universities and community colleges, including three that grant life science Ph.D.s. As a result, San Diego is home to the highest number of Ph.D.s per capita in the U.S. *(CHI/PWC, 2002)* During the past two decades, the life science market has built up a formidable network of supporting resources, such as venture capitalists, headhunters, and patent attorneys, all intimately familiar with the special needs of the biotech industry.

MAJOR PLAYERS

One of the top scientific R&D universities in the country, UCSD, is located in La Jolla, adjacent to several leading nonprofit research institutions such as The Scripps Research Institute, The Salk Institute and The Burnham Institute. The research being conducted at these institutes has led to the formation of many renowned life science companies, including Neurocrine Biosciences and Ligand Pharmaceuticals. Additionally, this research infrastructure has attracted some of the largest commercial life science companies to establish a presence in the region: eight of the world's foremost pharmaceutical companies now have major operations in the area.

Another outcropping of the institutional climate is the formation of key partnerships with local biotechnology pioneers to foster growth while providing companies with the financial freedom to develop innovative new products.

INDUSTRY DRIVERS*

INDUSTRY DRIVERS	TOTAL	RANK**
Life Scientists 1998	>1,400	8
NIH Funding 2002 *(in millions)*	$937	4
Venture Capital Funding for Biotech Companies 2003 *(in millions)*	$306	4
Biotechnology Patents *(1990-1999)*	1 632	5
Number of Biotechnology Companies 2002	109	5

Source: Scripps Research Institute, www.scripps.edu

Major Players

Major Institutions

Academic Research/ Medical	Clinical Teaching Hospitals	Independent Research Institutions
University of California at San Diego	Scripps Mercy Hospital	Burnham Institute
	University of California at San Diego Medical Center	Salk Institute for Biological Studies
		Scripps Research Institute
		Torrey Pines Institute for Molecular Studies

Major Sector Players

Pharmaceutical Companies	Biotechnology Companies	Medical Device Companies
Biogen-Idec	Amylin Pharmaceuticals, Inc.	Acon Laboratories, Inc.
Johnson & Johnson *Carlsbad*	Arena Pharmaceuticals, Inc.	ATI Medical
Merck Research Laboratories	Invitrogen Corporation *Carlsbad*	BD Biosciences - Pharmingen
Novartis Pharmaceuticals	Isis Pharmaceuticals, Inc. *Carlsbad*	Digirad Corporation, Poway
Pfizer, Inc.	Ligand Pharmaceuticals, Inc.	Gen-Probe Incorporated
	Maxim Pharmaceuticals, Inc.	Genetronics, Inc.
	Neurocrine Biosciences, Inc.	LMA North America, Inc.
		Smith & Nephew, Inc.

Lab Market Snapshot

The 9.6 million square foot San Diego life science market is currently seeing the highest amount of available wet lab space in the history of the cluster – partially attributable to both Pfizer and Biogen-Idec consolidating multiple sites in new campuses. The lab space includes investor-owned lab space consisting of more than 20,000 square feet that has been constructed or retrofitted specifically to accommodate life science tenants. Geographically, the Torrey Pines submarket has emerged as the prime location for pharmaceutical and biomedical research in the region. The shortage of available land in Torrey Pines has accelerated the expansion of life science companies into adjacent markets such as UTC/Eastgate/Campus Point, Sorrento Mesa and Sorrento Valley. Further biomedical industry growth is occurring in neighboring Carmel Valley and Miramar as well as in the North County cities of Carlsbad and Oceanside.

Existing Lab Space

	Total SF	Available SF (Vacant/ Sublease)	Availability Rate
Torrey-Pines	5,203,868	364,345	7.0%
UTC - Eastgate, Campus Point	1,012,135	146,900	14.5%
Sorrento Mesa	1,937,868	287,923	14.9%
Sorrento Valley	1,485,624	404,259	27.2%
Total Leased Space	9,639,495	1,203,427	12.5%

Market Asking Rents		
	Asking Rent psf	TI Allowance psf
Torrey-Pines	$34 - $42 NNN	$100 - $175
UTC - Eastgate, Campus Point	$33 - $37 NNN	$100 - $150
Sorrento Mesa	$24 - $36 NNN	$100 - $150
Sorrento Valley	$21 - $30 NNN	$100 - $150

Market Segments

The **Torrey Pines** submarket, adjacent to UCSD and home to The Scripps Research Institute, The Burnham Institute and The Salk Institute, consists of over 5.0 million square feet of lab space. Life science companies in this submarket tend to partner with large corporations or are publicly-traded and most are focusing on very late-stage clinical trials or marketed products. Torrey Pines is home to some of the nation's most prominent companies in the life science industry, including Pfizer, Novartis, Merck & Co., Johnson & Johnson, BD Biosciences and Smith & Nephew and the cost for lab space is the highest rate in the region. Availability may increase slightly due to tenant relocation and/or campus consolidation. The 75-year-old Scripps Research Institute has led the nation in the treatment of cancer, neurological disorders, organ transplantation, cardiovascular disease, and kidney disorders. Scripps currently owns or leases more than 1.2 million square feet of laboratory and administrative space in Torrey Pines, employing a renowned staff of over 1,100 researchers.

Like Torrey Pines, the **UTC/Eastgate/Campus Point** submarket tends to attract mature, publicly-traded corporate tenants with well-advanced product development. The area is centrally located and offers numerous amenities, however further expansion is restricted due to the limited supply of developable land in the area. A small number of R&D facilities suitable for conversion to biotech and a few build-to-suit opportunities are available in this submarket, and typically proceed once a tenant commitment is in place. Amylin Pharmaceuticals, Biogen-Idec and Illumina, Inc. occupy or will occupy in excess of 600,000 square feet in this submarket. Biogen-Idec is consolidating its operations into a new 42-acre campus in UTC, where the $100 million first phase includes 250,000 square feet of office and research space.

The **Sorrento Mesa** submarket caters to early and mid-tier biotech companies. Several industrial/R&D buildings in the area have been converted to lab space offering tenants from the Torrey Pines or UTC/Eastgate submarkets more affordable alternatives. Build-to-suit sites are also available and Sorrento Mesa has become the logical expansion market for companies requiring more space. GenProbe, Diversa Corporation and Elan Pharmaceuticals have set up operations in the submarket while Vical, Inc. recently signed a 15-year lease for 67,000 square feet of lab and office space and Kalypsis, Inc., a drug research company, just occupied a 46,000 square foot facility.

The **Sorrento Valley** submarket developed as an ancillary market to Torrey Pines and is home to many startup biotech operations. With a base of older R&D buildings easily converted to lab space, this submarket provides an economical alternative for early stage companies. Approximately 39.7% of this market is biotech. Biosite, a 1996 startup, started in a 20,000 square foot facility in Sorrento Valley and now occupies 9 buildings in excess of 160,000 square feet. Development is taking place on a new 900,000 square foot campus. Phase I, approximately 300,000 square feet, will be completed in late 2005.

Recent Transactions

Tenant	Town	Size (SF)
Amylin Pharmaceuticals, Inc.	UTC-Eastgate-Campus Point	77,539
Anadys Pharmaceuticals, Inc.	Torrey Pines	55,000
GenProbe	Sorrento Mesa	29,141
Applied Molecular Evolution, Inc. ***(Eli Lilly)***	Sorrento Valley	19,054

Market Outlook

Overall market demand stands at 650,000 square feet, off almost 40% from 12 months ago. There is no speculative development underway at this time, and any build-to-suit or conversion activity will not proceed without a significant tenant commitment. More companies are receiving financing through venture capital firms and the capital markets, and it is anticipated that demand will increase over the course of 2004. Vacancy levels are expected to decrease in early 2005.

Incentives

California continues to be a strong supporter of the life science industry, promoting collaboration between the area's universities and companies. San Diego has effectively used its planning and zoning power to create an environment, which appeals to pharmaceutical, biomedical, research and development firms. In addition, San Diego has encouraged the development of a significant academic and professional community, providing a rich talent pool and helping to entice firms to expand within the market. Below are some of the public and private organizations that provide support services, economic development, and incentives.

- Institute for Bioengineering, Biotechnology and Quantitative Biomedical Research
- The Biotechnology Strategic Targets for Alliances in Research *(BioStar)* Program
- The California Healthcare Institute
- The California Public Employees Retirement System *(CalPERS)*
- California Technology Investment Partnership.
- BIOCOM

Source: "State Government and Biotechnology 2001," Battelle Memorial Institute, www.bio.org/tax/battelle.pdf

Pfizer • La Jolla, CA

Pfizer La Jolla, the outgrowth of Agouron Pharmaceuticals, Inc., was organized in 1984 to bring a fresh approach to the discovery of new therapeutic drugs for treatment of cancer, HIV/AIDS, diseases of the eye, diabetes and obesity. Pfizer La Jolla has developed an engineering approach to the design of novel synthetic drugs based upon the molecular structures of target proteins that play key roles in human disease. The existing La Jolla Campus includes 385,000 square feet of leased Research & Development facilities in the Torrey Pines Science Park, with expansion plans for an additional 385,000 square feet to be completed over the next several years. Other off-site leased facilities include 160,000 square feet of mixed lab, office and vivarium space. Pfizer has announced that it is continuing to make a substantial investment in San Diego due to cutting edge science and a highly-attractive West Coast location. Approximately 1,300 people currently work at the Torrey Pines location.

Source: Pfizer website

CHICAGO

Chicago's emerging life science cluster revolves around a core of academic and medical research institutions and patient care facilities. The Chicago area is home to several leading academic research universities with medical centers. The University of Chicago boasts 75 Nobel Prize winners, more than any other American university. The Chicago area has over ninety hospitals, eight of which have been ranked in the top twenty nationally for a specialty area by U.S. News and World Reports. With over 12,000 physicians, the Chicago area has the nation's largest medical community. Chicago also has several key specialty research and patient care institutions that feed the life science and health care sectors.

The pharmaceutical industry has an established presence in Chicago area. The global headquarters for Abbott Laboratories and Abbott's Global Pharmaceutical Research and Development division are located in North Chicago along Lake Michigan. In addition, Baxter International is headquartered in Deerfield, IL. Although the pharmaceutical ranks have been thinned due to recent mergers *(e.g. Pfizer acquiring Pharmacia in 2003)*, the arrival of two major Japanese pharmaceutical companies to the area, Takeda and Fujisawa, has further strengthened the cluster.

Federal and private funding to the life science industry has been consistent in Chicago, with the city ranking 13th in NIH funding in 2002. The Chicago Technology Park Research Center *(above)* is one of two bioscience incubators that exist to help house and foster new companies. The 57,000 square foot center, which houses 40 state-of-the-art wet labs, was developed by the State, the University of Illinois at Chicago, and the Illinois Medical District Commission.

Two organizations were established in recent years to promote, develop and create a private and public sector infrastructure to support regional biotechnology: the Illinois Biotechnology Association *(BIO)* and the Chicago Biotechnology Network Association *(CBN)*.

Source: "Chicago Bioscience Market Demand Analysis" Building Block Solutions; National Institutes of Health: Office of Extramural Research: http://grants.nih.gov/grants/awards/awardtr.htm

HOUSTON

The Texas Medical Center *(TMC)* is the epicenter of the life science industry in Houston. The world's largest medical center, the TMC is located on 740 acres just eight minutes from downtown Houston, and employs over 61,000 workers. The TMC is home to 42 non-profit and government institutions, including 13 teaching hospitals and two medical schools. The 100 existing buildings in the TMC comprise a total of 22.0 million square feet of physical plant space.

Houston is buoyed by over $1 billion in annual development funding *(most of it from the TMC)*, and nearly half of over 100 life science companies operating in Houston in 2003 were formed as a direct result of the financial support from the medical institutions of the TMC. Already a leader in biodefense and infectious diseases, the Houston region was the recipient of nearly $160 million in grants in 2003 from the U.S. Department of Health and Human Services and NIH. These grants will fund the development of one of the first National Biocontainment Laboratories *(a BSL-4 lab)*, an estimated $180 million dollar project, at the University of Texas Medical Branch at Galveston *(UTMB)*. UTMB is already home to the World Health Organization Collaboration Center for Tropical Diseases and a Biosafety Level 3 *(BSL-3)* laboratory.

Development is underway on the region's only business park dedicated to life sciences, The Spectrum at Clear Creek *(above)*. Just eight miles south of TMC, the Spectrum represents the convergence of science, technology, training and lifestyle. The Spectrum will be home to emerging biotech and technology-based corporate headquarters, development laboratories and manufacturing and distribution facilities, all of which will be supported by a business hotel and conference center, retail and entertainment establishments, technical educational training facilities, and other amenities. Expected land prices will range from $4 - $8 per square foot, depending on the location within the park, access to the site, and frontage. Fully-developed sites will be available for the construction of facilities in January 2005.

Source: Texas Medical Center, www.tmc.edu

INDIANAPOLIS

Since 2002, Central Indiana's ties to scientific research and innovation have greatly expanded with focus on Indianapolis as a growth center. The City of Indianapolis, Eli Lilly & Company, the Central Indiana Corporate Partnership, Indiana University, Purdue University and the Indiana Health Industry Forum founded the Central Indiana Life Sciences Initiative, recently renamed "BioCrossroads." BioCrossroads represents a joint effort focusing on eight target areas of the life science industry including, agribiotech, biosensors, cancer treatment, cardiovascular, evidence-based medicine, neuroscience, proteomics and sports-centered life sciences. The BioCrossroads initiative has been instrumental in making Central Indiana a life science hub in the global market. In November 2003, Business Facilities magazine ranked Central Indiana as the 19th top location in the U.S. for biotechnology companies. Although Central Indiana has not been a top receiver of NIH funding, Indiana University received 356 grants totaling almost $129 million in 2003.

Downtown Indianapolis is rapidly evolving into a collaborative life science research community which includes the Indiana University Emerging Technologies Center, a 39,000 square foot biotechnology-focused business incubator, and the Indianapolis Science & Technology Park *(above)*. Eli Lilly, headquartered in Indianapolis, is doubling the size of its biotechnology complex with a 477,500 square foot, $200 million, four-story laboratory building. The Purdue Research Park, located to the north of Indianapolis, is now home to more than 90 companies, employing more than 2,500 people. In addition, 60,000 square feet of space will be added to the park's business incubator, doubling its size. According to the National Incubation Association, Purdue Research Park is the largest university-affiliated incubation complex in the country. Also in the planning stages is a clinical laboratory for Clarian Health, Indiana University's 170,000 square foot Life Science Building and 120,000 square foot graduate center and a 120,000 square foot multi-tenant building with wet and dry lab space.

Source: "BioCrossroads," www.biocrossroads.com

MEMPHIS

Memphis boasts two significant drivers of the life science industry: St. Jude's Children's Research Hospital and the University of Tennessee Health Science Center *(UTHSC)*. St. Jude's is one of the world's premier centers for research and treatment of catastrophic diseases in children – primarily pediatric cancers. The hospital's current basic and clinical research includes gene therapy, cancer, HIV and other illnesses. St. Jude's is the only pediatric research hospital supported by a National Cancer Institute *(NCI)* Cancer Center Support Grant. Additionally, in 2002 St Jude's received over $58 million in NIH grants. Currently, the hospital is in the midst of a five-year, $1 billion expansion, which will more than double the size of its campus and bolster research efforts.

UTHSC, formed by the consolidation of five medical schools *(including the College of Medicine pictured above)* and schools of dentistry and pharmacy, is the largest academic health science center in the southeastern U.S. The Center's 55-acre urban campus includes a children's research hospital, a Level I trauma center, a major Veterans Affairs facility and 6 outstanding private hospitals and specialty clinics. UTHSC, in collaboration with several primary partners, has been awarded a cooperative agreement for approximately $14 million from the National Institute of Allergy and Infectious Diseases *(NIAID)* to construct a Regional Biocontainment Laboratory *(RBL)* that will be used for biodefense and microbiological research related to serious emerging infections.

In addition to these two life science hotbeds, the Memphis Biotech Foundation *(MBF)* has begun the construction of the UT/Baptist Research Park, which will consist of 1.2 million square feet of laboratory space located in Memphis's medical district. The first phase of development of the Park is a six-story, 165,000 square foot biotechnology research facility. The Park will also include an incubation program to develop new business in biotechnology and foster job growth. The MBF projects new investment of over $1 billion will result from development of the Park, which will help to establish the Memphis biotech region.

Source: Memphis Biotech Foundation, www.memphisbeach.org

St. Louis

The St. Louis life science cluster is supported by a foundation of academic research and development that is strongly focused on plant and life science. The Coalition for Plant and Life Sciences, a coalition of business, civic, research and academic leaders, is striving to position St. Louis as an international center for biomedical and plant sciences. The Coalition has established a commercialization project called the BioGenerator, a nonprofit entity with the purpose of transforming promising ideas and technologies developed in the research laboratory into start-up commercial enterprises.

There are four major academic institutions in St. Louis. Established life science companies in the area include the Monsanto Company, Pfizer and Sigma-Aldrich, but there is a growing number of smaller biotech companies in the region as well. In addition to academic institutions and private companies there are numerous, prominent independent research institutions in the St. Louis area including the Center for Emerging Technologies, which was ranked in the top 10 incubators in the country by the National Business Incubation Association in early 2003.

The market contains a full range of life science facilities including new space, second generation space and incubator facilities. Current existing market availabilities total approximately 325,000 square feet, which includes 75,000 square feet at the Danforth Plant Science Center *(above)*, 60,000 square feet at a former Solutia facility, 56,000 square feet at Incyte Genomics' former facility and incubator space at the Center for Emerging Technologies. In the proposal stages is significant lab space in three buildings totaling 180,000 square feet at North 8, located on the Danforth Plant Science Center campus, and in 230,000 square feet being redeveloped in mid-town St. Louis between Washington University and St. Louis University.

In 2002, 19 development-stage biotech, life science and health care services companies received over $103 million in venture funding. The Missouri Development Finance Board has provided some $12 million in tax credits to be leveraged with contributions from private donors, philanthropies and institutions to help purchase land for the Center of Research, Technology and Entrepreneurial Expertise *(CORTEX)*. CORTEX is a public purpose non-profit funded by research organizations including Washington University, BJC Health System, Saint Louis University, University of Missouri at St. Louis and the Missouri Botanical Garden, to create an environment whre commercial life science endeavors can thrive in close proximity to where research is taking place.

Source: BioBelt, www.biobelt.org

Wisconsin

Wisconsin, in primarily the Madison and Milwaukee areas, represents a promising emerging market in the life science industry. The Wisconsin Biotechnology & Medical Device Association *(WBMDA)*, based in Madison, lists approximately 150 life science companies. The WBMDA is in close proximity to the University of Wisconsin at Madison *(below)*, an institution that has a world-renowned reputation for scientific research. In 2003, UW Madison ranked 21st nationally for federal funding, receiving over $247 million in NIH grants, and it is estimated that the University brings in approximately $600 million total in outside research funds annually. The Wisconsin Alumni Research Foundation *(WARF)* is a private, non-profit organization which patents inventions evolving from the University research, warrants the technology for commercialization, and returns the income to UW Madison to support further research. WARF is responsible for $650 million reinvested in research at UW Madison since the organization was established in 1925.

Biotech companies are primarily located in Madison due to the presence of University Research Park, a 1.5 million square foot campus comprised of 34 buildings on 255 acres and a 13,000 square foot incubator site, the Madison Gas & Electric Innovation Center. Like WARF, University Research Park returns all profits to UW Madison research programs to fuel technology transfer and economic growth. Approximately 100 companies occupy the park, employing over 4,000 people. In addition to life science companies, the park is also home to core services such as accountants, lawyers, and venture capitalists.

Source: "America's Third Coast Nutures Biotechnology," Genetic Engineering News, March 1, 2004.

CANADA

TORONTO

The city of Toronto, in the province of Ontario, Canada is evolving into a life science cluster focused on biopharmaceuticals and diagnostics. With the University of Toronto, seven metropolitan hospitals and twenty-five local research institutes, Toronto maintains the substantial academic infrastructure for R&D and the highly-educated work force necessary for any life science cluster. Additionally, startup life science companies benefit from the region's significant federal and provincial funding options which include the $3 billion Ontario Research and Development Fund, the $1.0 billion Ontario Innovation Trust, and the commitment of the Canadian Institute of Health Research to increase the amount of grants awarded to $1 billion by 2007. Major pharmaceutical companies that have a presence in Toronto include AstraZeneca, GlaxoSmithKline, and Hoffmann-LaRoche.

Phase I of Toronto's first life science research park, a 1.3 million square foot master planned complex known as the Medical and Related Sciences *(MaRS)* Discovery District, is currently under construction. Phase I consists of a 400,000 square foot research tower, the Toronto Medical Research Tower *(above)*, which is expected to be completed in the fourth quarter of 2004. The Tower is entirely programmed as a lab facility, with a breakdown of 80% wet lab and 20% dry lab. It will offer shared services including, among many others, Biosafety Level 3 labs *(BSL-3)*, sterilization, Nuclear Magnetic Resonance and animal resources. 55% of the tower is pre-leased to the University Health Network, and the remaining 150,000 square feet of the building is commercially-available. The MaRS project will provide Toronto with valuable commercial lab space for startups and established companies alike, creating a global address for the commercialization of discovery and a national public benefit - the creation of employment opportunities and new wealth for Canadians.

Source: Toronto Initiative, www.torontobiotech.org

VANCOUVER

Between 1991 and 2001, 60 new biotechnology companies were created in Vancouver, making it the 3rd fastest growing city in North America. Only San Francisco *(71)* and Boston *(65)* founded more companies during that decade. Today, there are approximately 90 biotech firms located in the city's cluster, employing about 2,593 people. The growth of local firms is largely attributed to a solid research and life science culture fostered by the University of British Columbia *(UBC)* and its affiliated teaching hospital. In 1984, UBC founded its University-Industry Liaison Office *(UILO)*, a high performance team that guides breakthrough UBC research to business reality. 91 spin-off companies have since been created, resulting in the generation of 2,100 new jobs. Not coincidentally, UBC holds the most patents in Canada next to Nortel. The UILO has also managed to raise more than $1.3 billion from private investors.

Vancouver's biotechnology cluster is quickly gaining an international reputation for housing the industry's top-performing emerging companies. Most notably, Angiotech Pharmaceuticals, Inc. *(above)* was NASDAQ's top performing biotech firm for 2003. The city's biotechnology sector is also considered well-funded. According to BC Biotech, in 2003 British Columbia companies accounted for 45% of all public biotech financings and 34% of all private financings in Canada. Angiotech Pharmaceuticals, for example, completed a $250 million round and QLT Inc. raised $172 million in public offerings. The $24.5 million raised by NeuroMed Technologies, Inc., meanwhile, topped the list for private biotech-oriented capital raised over the course of the year.

Due to the prominent role that UBC and Vancouver's General Hospital play within the biotechnology community, Vancouver's biotechnology cluster appears to be forming largely in the areas surrounding these facilities. The emerging cluster currently features more than 24 buildings, totaling approximately 900,000 square feet of space designed to specifically meet the needs of the

Source: "Vancouver: A North American Biotechnology Cense;" Vancouver Economic Development Commission; BC Biotech, Discovery Parks Inc., October 2002.

biotechnology sector. With asking lease rates ranging between $12 -$20 per square foot NNN *(US)*, and averaging around the $14 per square foot NNN *(US)* mark, Vancouver rates are considered highly-competitive relative to offerings available in other cities. When combined with cost advantages, such as an affordable yet highly-skilled workforce, Vancouver ranks as one of the most cost-competitive areas for biotechnology. The area's five most remarkable facilities are Discovery Place *(400,000 SF)*, False Creek Research Station *(eventually 250,000 SF)*, UBC Research Park *(192,000 SF)*, BC Research Complex *(185,000 SF)*, and the Echelon Innovation Center *(67,426 SF)*.

EUROPE

Europe produces more than 40% of the world's pharmaceuticals, making it the leading pharmaceutical manufacturing location ahead of the U.S. *(over 30%)* and Japan *(20%)*. However the policies that the European Union *(EU)* has put in place to curb pharmaceutical expenditure have caused the European life science R&D industry to lose its top ranking to the U.S. in the past ten years. U.S. companies are able to funnel profits directly back into R&D because they are not constrained by such regulations in their home markets. In the U.S., incentives for innovation, the regulatory framework and public attitudes toward new technologies combine to create a more favorable climate for life science R&D. Thus, many European countries are deploying resources for investment in R&D to the U.S., resigned to the fact that Europe is a less attractive R&D investment location. France, Germany, the United Kingdom and Switzerland are the leaders in pharmaceutical production as well as R&D expenditures. Large European pharmaceutical companies include GlaxoSmithKline (United Kingdom), Aventis (France) and Boehringer Ingelheim (Germany).

Two obstacles that Europe faces to growth in the life science industry are the lack of a governmental funding agency with substantial resources, such as the NIH, and the existence of price controls. The EU's main funding instrument for research in Europe is the Framework Programme for Research that is open to all public and private entities, large or small. The overall budget for the four-year period between 2003 and 2006 is 17.5 billion euros, only a portion of which is designated for life sciences. The NIH's $23 billion annual budget is 50 times the amount allotted for R&D under the EU initiative. European life science firms also benefit from the world's largest medical research charity, The Wellcome Trust, which has joined with the United Kingdom to launch a £600 million fund to transform the scientific research environment within UK universities.

Source: "Life Science 7 Biotechnology- A Strategy for Europe," Commission of the European Communities, January 2002.

JAPAN

Japan's entrance into the international life science community can be traced back to the 1960's, when the nation's breweries discovered that the fermentation process could be adapted to serve the biotechnology industry. Today, Japan is the second largest health care economy in the world, and Japanese companies account for approximately 12% of the global pharmaceutical market. Established life science companies from around the world are considering locating in Japan, taking into account the country's large market size and the socialized healthcare system that offers prescription drug reimbursements up to ten times higher than those in the U.S.

The Japanese government is actively promoting its life science market by identifying genetic research as one of eight Millennium Projects, pledging to double the life science development budget in the next five years, and refocusing the Japanese External Trade Organization *(JETRO)* to match U.S. life science companies with their Japanese counterparts. The government's initiatives are expected to improve the funding options for small companies and attract companies from the U.S., a move that was formerly discouraged by rigid cultural differences. In addition to increased international activity, a new law has been passed that will allow faculty members of the country's academic institutions to simultaneously be employed by a life science company, a situation that was previously prohibited by law. The intended effect is that local breakthroughs will be

Source: "Japan Launches New Life Science Initiatives," Nature Biotechnology, March 2003.

commercialized and developed within Japan, instead of being exported to another country. The financial opportunity and the high prescription drug consumption should continue to lure pharmaceutical companies from around the world to Japan's life science market.

CHINA

China is rapidly emerging as a formidable life science market, anchored by its expertise in genomics and drugs developed from natural sources. Scientists at the Beijing Genomics Institute, one of the world's largest gene decoding operations, decoded the rice genome in four months, a project that was predicted to take ten years. China's long history of herbal medicine has evolved into the exploration of drugs derived from natural sources. Additionally, China has excelled in stem cell research, with four laboratories reported to be cloning human embryos to harvest stems cells. Unlike their American counterparts, Chinese scientists are not restricted by governmental regulations on stem cell research and cloning.

Traditionally, China has had a difficult time attracting companies to the mainland because of a lack of commercialization, patent protection and venture capital funding. In addition, China has suffered from a substantial "brain drain," with 300,000 students having left the country to study in Europe or the United States since the 1970's. The majority of these students did not return to their homeland, choosing instead to live and work abroad. However, this trend is shifting, as an increasing number of foreign-educated students are willing to return to China to establish startups. The government is working to implement incentives for the life science industry, including comparable salary packages with stock options and the institution of stricter patent and intellectual property protection. The Chinese government is also seeking new ways to encourage foreign capital sources to enter the Chinese market.

Source: "Life Science & Biotechnology in China," Speech by Mr. Jin Ju, Head of the Chinese Delegation, June 2001.

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Notes

* The statistics listed in the Industry Drivers and Major Players sections in each of the major U.S. clusters were compiled from the following sources:
  - "Signs of Life: The Growth of Biotechnology Centers in the U.S.," by Joseph Cortright and Heike Mayer-The Brookings Institution Center on Urban and Metropolitan Policy, 2002
  - National Institutes of Health: Office of Extramural Research: http://grants.nih.gov/grants/awards/awardtr.htm
  - Pricewaterhouse Coopers MoneyTree Survey Historical Trend Data: http://pwcmoneytree.com

** The Rank listed in the far right column of these tables is based on Spaulding & Slye Colliers' comparison of the information compiled on the nine primary life science clusters.

Asking Rents are quoted triple net (NNN), meaning the tenant is responsible for all costs associated with its share of the property typically including real estate taxes, all operating expenses, and insurance.

This publication is designed to provide accurate and authoritative information in regard to the subject matter which is covered herein. We have made a reasonable effort to assure the timeliness and accuracy of the information contained herein, and all sources of data used are deemed to be reliable. However, we assume no responsibility whatsoever for the accuracy of those sources, and acknowledge that some information contained herein may be preliminary in nature and provided with the understanding that it is not guaranteed to be correct or complete. Conclusions drawn from such information are the responsibility of the user.

"He wondered by what **ALCHEMY** it was changed, so that what sickened him one hour, maddened him with hunger the next"

Marjorie K. Rawlings

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